

BRITISH MUSEUM (NATURAL HISTORY)

THE
JOHN MURRAY EXPEDITION
1933-34

SCIENTIFIC REPORTS

VOLUME VI, No. 2

OPHIUROIDEA

BY

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(Museum of Comparative Zoology, Cambridge, Mass., U.S.A.)

WITH SIXTY-TWO TEXT-FIGURES



LONDON:

PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM

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STREET, LONDON, W. 1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C. 4;
H.M. STATIONERY OFFICE, LONDON, S.W. 1

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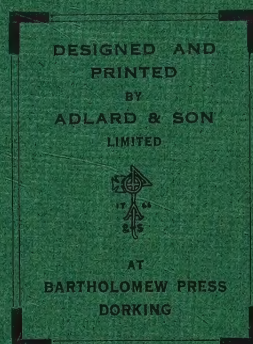
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W. 7

1939

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Price Ten Shillings

[Issued 28th October, 1939]



Made and printed in Great Britain

OPHIUROIDEA

BY

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WITH SIXTY-TWO TEXT-FIGURES.

THE British Museum, through Dr. W. T. Calman, has done me the honour of asking me to prepare a report on the collection of brittle-stars (Ophiuroidea) made by the John Murray Expedition to the Indian Ocean in 1934. The preparation of such a report has proved both more interesting and more time-consuming than had been anticipated; interesting because the area in which the collection was made has been a veritable *terra incognita*, so far as the ophiurans were concerned; time-consuming as the number of species represented was greater, and the proportion of undescribed forms much greater, than was expected. Apparently the conditions in the north-western Indian Ocean are very favourable to brittle-star life and have resulted in a large and varied ophiuran fauna.

The collection consists of 2261 specimens, representing 102 species of 42 genera. While these are distributed in 11 families, 71 of them belong to the families Ophiacanthidæ, Amphiuridæ and Ophiolepididæ; almost one-third of the species (31 to be exact) are members of this last-named family. Of the 42 genera recognized, no fewer than 6 are groups here named for the first time. No one of these is formed by the breaking up of a previously known genus, but each is needed to accommodate an ophiuran, with such a striking character or such an unusual combination of characters, that a new generic name seemed advisable, if not positively required. Half of these new genera are Amphiuridæ and half are Ophiolepididæ. All but one are monotypic; that one contains two species, but one of the two is represented by only two specimens, and the other is based on a single small individual. Only one of the new genera is represented by a really adequate amount of material. It is, of course, regrettable that so many new groups rest on such slight foundation, but it is the unescapable penalty of having to report on a collection made in a little-known area by an expedition to which the collecting of ophiurans was but incidental to its main purpose.

Of the 102 species, exactly one-third (34) are here named and described for the first time. As would naturally be expected, the bulk of these new forms are Amphiurids (12 species), or Ophiolepidids (11 species), but 5 are Ophiacanthids. It is regrettable that 5 new species must be added to the already over-burdened genus *Amphiura*, but it is hoped the descriptions and figures are adequate, not only for their recognition, but for their proper disposition when the dismemberment of *Amphiura* takes place.

It is, of course, necessary to assume that the 34 new species are endemic, although it is probable, if not certain, that the range of many will prove to extend far to the south and east of the area explored by the "Mabahiss". The geographical relationships of the 68 previously known species are of much interest as indicating the probable sources from which the fauna has been derived. There follows, therefore, a list of the stations where ophiurans were taken, arranged according to the geographical areas recognized in the reports of the Expedition. A brief discussion of the species involved is given in connection with each area.

LIST OF STATIONS WHERE OPHIURANS WERE TAKEN, ARRANGED ACCORDING TO AREAS.*

RED SEA.

September 17th, 1933 :

St. 10 ; 55 m. *Ophiothrix otiosa*, *Placophiothrix purpurea*.

St. MB I ; 26-29 m. **Amphiura dejectoides**, *Ophiactis hexacantha*, *plana*, *savignyi* and **versicolor**, *Ophiothrix demessa* and *otiosa*, *Placophiothrix purpurea*, *Ophiotrichoides propinqua*, *Ophiurodon cupidum*, *Ophiura kinbergi*.

May 16th and 17th, 1934 :

St. 206 ; 256 m. *Amphioplus hastatus*.

St. 208 ; 732-805 m. *Ophiocirce inutilis*.

Of these 13 species, only 3 are new, and one of these (*Ophiactis hexacantha*) was also taken at the Maldives. Of the remaining 10 species, 5 are widely distributed in the Indo-Pacific region, 4 others are East Indian, but one (*Amphioplus hastatus*) was known to reach Mozambique and another (*Placophiothrix purpurea*) Madagascar. The single remaining species (*Ophiothrix otiosa*) was known only from the Malabar coast of India. Only 2 are from deep water (exceeding 200 m.). It is notable that only one of the 13 species was taken in the Suez Canal by the 1924 Cambridge Expedition (see Mortensen, 1926), and this was the ubiquitous *Ophiactis savignyi*.

GULF OF ADEN.

September 21st, 1933 :

St. 16 ; 186 m. **Amphioncus platydiscus**.

October 9th-16th, 1933 :

St. 24 ; 73-200 m. *Ophiacantha durbanensis* and *pentagona*, **Amphiura crypta**, *Ophiactis plana*, *Placophiothrix aristulata*, *infirmata* and *purpurea*.

St. 25 ; 620 m. *Ophiacantha pentagona*, *Placophiothrix aristulata*, *Amphiophiura paupera*.

St. 26 ; 2312 m. *Ophiacantha vorax*, *Bathypsectinura conspicua*, **Ophiuraster perissus**, *Ophiura irrorata*, *Ophiomusium altum*, *Ophiernus vallincola*.

St. 27 ; 37-91 m. *Ophiothrix demessa*, *Placophiothrix phriza* and *purpurea*.

St. 33 ; 1295 m. **Amphiura ceramis**, **Anophiura planissima**, *Ophiomusium elegans*.

St. 34 ; 1022 m. *Bathypsectinura conspicua*, *Ophiocrates secunda*.

St. 35 ; 457-549 m. *Ophiernus adpersum*.

* New species in black-face type.

May 2nd-7th, 1934 :

St. 176 ; 655-732 m. *Amphiura grandisquama*.

St. 184 ; 1270 m. *Ophiotreta eximia* and *matura*, *Ophioplinthaca papillosa* and *rudis*, *Ophiophthalmus relictus*, **Amphiura ceramis**, **Homalophiura euryplax**.

St. 185 ; 2000 m. **Amphiura ceramis**, *Ophiura irrorata*, **Ophiozonella brachyactis**, *Ophiotrochus longispinus*.

St. 193 ; 1061-1080 m. **Anophiura plannissima**, *Ophiernus adpersum*.

Of these 31 species, 9 are new and 5 of these were not taken outside the Gulf of Aden ; *Amphiura ceramis* was taken near Zanzibar, *Placophiothrix phriza* ranges along the South Arabian coast, and *Ophioplinthaca papillosa* extends to the Maldives. Of the remaining 22 species, 8 are East Indian, not known west of the Bay of Bengal, 3 others are East Indian, with their range reaching the Laccadive Islands, another reaches Madagascar, and another South Africa. The occurrence of these species in the Gulf of Aden is interesting evidence that the East Indian fauna tends to reach all parts of the Indian Ocean area. The occurrence of the Japanese *Ophiotrochus longispinus* merely shows that it too belongs to the East Indian fauna. Widespread throughout the Indo-Pacific area is *Ophiethrix demessa*, while *Ophiactis plana*, *Ophiura irrorata* and *Ophiernus adpersum* are virtually world-wide in their distribution in deep water. Approaching this group is *Amphiura grandisquama*, which was first found in the waters of Florida and the West Indies, but is now known from St. Helena (deep water), Natal and the Philippine Islands. Another South African species, *Ophiacantha durbanensis*, now turns up in very moderate depths in the Gulf of Aden. Each of the two remaining species has a notable, and at present inexplicable, range : *Ophiernus vallincola* was first taken in the North Atlantic, later in the Antarctic, and then in the Gulf of Panama, so it is probably more or less nearly cosmopolitan, but its occurrence in the Gulf of Aden is certainly unexpected ; *Ophiocrates secunda* has hitherto been known only from very deep water (2325-2640 m.) off Rio de Oro, West Africa, so its occurrence in water only 1022 m. deep in the Gulf of Aden is hard to understand ; the "Mabahiss" also took it, however, in the Maldivian area in 786-1180 m.

SOUTH ARABIAN COAST.

October 27th-29th, 1933 :

St. 42 ; 1415 m. *Ophiacantha pentagona*, *Amphiura uncinata*, *Ophiozonella molesta*.

St. 43 ; 83-100 m. *Placophiothrix aristulata*.

St. 45 ; 38 m. *Ophiacantha pentagona*, *Amphioplus hastatus*, *Ophiactis carnea*, *Ophiethrix otiosa*, **Placophiothrix phriza**, *Macrophiethrix brevipeda*, *Ophiethela caerulea* (? **Ophiochiton megalaspis**), *Ophionereis australis*, *Ophiurodon cupidum*.

October 28th, 1933 :

St. MB II ; 11-29 m. *Amphioplus hastatus*, *Ophiactis carnea*, *Ophiodaphne materna*, *Placophiothrix proteus*, *Ophiethela caerulea*, *Ophiura kinbergi*.

November 2nd-6th, 1933 :

St. 53 ; 13.5 m. *Ophiactis carnea*, *Macrophiethrix brevipeda*, *Ophiethela caerulea*.

St. 54 ; 1046 m. *Ophiacantha abnormis*, *Amphiura diomedea*, **eugenoides** and **megalaspis**, *Placophiothrix purpurea*, **Ophiochiton megalaspis**, **Ano-phiura simplex**.

St. 59 ; 1948 m. *Ophiura irrorata*.

November 30th, 1933 :

St. 80 ; 16-20 m. *Ophiura kinbergi*.

Of these 23 species, 9 (possibly 10) were taken at St. 45 in shallow water. This is the largest number of species of brittle-stars taken by the "Mabahiss" at any station. It is unlikely that *Ophiochiton* was taken here, but the others form a very interesting and perhaps typically Arabian group. Of the entire list of 23 species only 5 are new, and 1 (*Placophiothrix phriza*) of these was taken in the Gulf of Aden also. Of the other 18 species, 12 are East Indian, but several range westward to the Laccadives or to Madagascar or South Africa. One species *Ophiothela caerulea*, is as yet known only from the Arabian coast, while *Ophiothrix otiosa* ranges from the Red Sea to the Malabar coast. One species, *Ophiura irrorata*, is practically cosmopolitan in deep water, while *Amphiura diomedea* ranges from South Africa to Panama. The 3 remaining species, *Ophiactis carnea*, *Macrophiothrix brevipeda* and *Ophionereis australis*, were hitherto known only from South Africa, and their occurrence on the South Arabian coast in very shallow water (11-38 m.) is quite extraordinary. Whether they are really absent from the whole East African coast north of Mozambique is, of course, open to question, and further study of the East African littoral fauna is greatly to be desired.

NORTHERN AREA OF ARABIAN SEA.

November 18th, 1933 :

St. 62 ; 1893 m. *Ophiacantha vorax*, *Ophiotreta eximia*, *Ophiotoma assimilis*, *Ophiura irrorata*, *Ophiernus vallincola*.

December 6th and 7th, 1933 :

St. 85 ; 1519-1705 m. *Ophiernus vallincola*.

St. 89 ; 135-193 m. **Ophiothamnus longibrachius**, *Amphioplus hastatus*.

Only 1 of these 7 species is new to science and that is based on a unique shallow-water specimen. The other 6 are East Indian, or even more widely spread deep-water forms ; only 1 occurs at depths less than 1200 m.

GULF OF OMAN.

November 26th and 27th, 1933 :

St. 71 ; 106 m. *Ophiura kinbergi*.

It is evident that the ophiuran fauna of the Gulf of Oman is scanty, for a single very young individual of this species was the only brittle-star taken in eight hauls of dredge and trawl, not to mention three "grabs".

CENTRAL AREA OF THE ARABIAN SEA.

April 28th, 1934 :

St. 171 ; 3840-3872 m. *Ophiotypa simplex*, *Ophiopyrgus alcocki*, **Ophiochorus granulatus**, *Amphiophiura convexa*, *Ophiura irrorata*, *Ophiomusium nitidum*.

In some respects this was one of the most interesting hauls made by the "Mabahiss"—only one other was made in deeper water, and that was spoiled by a badly-torn net; no ophiurans were secured. Of the 6 species taken at St. 171, 2 are new, but 1 of these was also taken at St. 120 in the Zanzibar area, at a depth of 2926 m. Of the remaining 4 species, 3 were also taken at St. 120, and the fourth at St. 119, 1207–1463 m. Koehler's odd species, *Ophiotypa simplex* and *Ophiopyrgus alcocki*, were hitherto known only from the Bay of Bengal, while *Ophiura irrorata* is cosmopolitan in depths exceeding 1000 m. and *Amphiophiura convexa* has an equally wide distribution, but seldom occurs at less than 2500 m. Obviously, therefore, the ophiuran fauna of the central portion of the Arabian Sea is a very typical deep-water fauna, but with possibly half the species confined to the Indian Ocean.

ZANZIBAR AREA.

January 11th–24th, 1934 :

- St. 105 ; 238–293 m. *Ophiomyxa bengalensis*, **Amphiura ceramis**, *Amphiura uncinata*, **Anamphiura valida**, *Ophiomusium breve*, and *lütkeni*, *Ophiomusa ultima*.
- St. 106 ; 183–194 m. **Ophiothrix amphibola**, *Ophiomusium lütkeni*, *Ophiocirce inutilus*.
- St. 107 ; 421–457 m. *Ophiomusium validum*.
- St. 108 ; 786 m. *Ophioplinthaca rudis*, *Ophiomusium familiare*.
- St. 109 ; 640 m. *Ophiomyces delata*, *Amphiophiura paupera*, *Ophiomusium familiare*.
- St. 110 ; 347–384 m. *Ophiomusium familiare*.
- St. 111 ; 73–165 m. *Ophiocoma insularia* var. *variegata*, *Ophiocirce inutilus*.
- St. 113 ; 220 m. *Amphiura atlantica*.
- St. 115 ; 640–658 m. *Bathypectinura conspicua*, *Ophiomusium familiare* and *validum*.
- St. 118 ; 1789 m. **Ophioplinthaca crassa**, *Amphiophiura trifolium*, *Ophiomusium altum*.
- St. 119 ; 1207–1463 m. *Ophioplinthaca rudis*, *Ophiopyrgus alcocki*, *Ophiomastus tumidus*, *Ophiura aequalis* and *irrorata*, *Ophiomusium cancellatum*.
- St. 120 ; 2926 m. *Ophiacantha cosmica*, *Ophiolimna antarctica*, *Ophiotypa simplex*, **Ophiomastus platydiscus**, **Ophiochorus granulatus**, *Amphiophiura convexa* and *sculptilis*, *Ophiura irrorata*.
- St. 122 ; 732 m. *Bathypectinura conspicua*, *Amphiophiura paupera*.

Of these 32 species, the largest number secured by the "Mabahiss" in any one of the areas under consideration, only 7 represent undescribed species, but 2 others (*Amphiophiura trifolium*, *Ophiomusa ultima*) were only recently (Hertz, 1927) described from off East Africa. Of the other 23 forms, 4 are more or less cosmopolitan in deep water, and another is widespread in the Indo-Pacific region. Of the remainder, 16 are East Indian forms of more or less wide distribution, leaving only 2 species whose range is at all notable. One of these (*Ophiolimna antarctica*) was originally described from the extreme southern Indian Ocean, but was taken by the "Mabahiss" in very deep water in the Maldivian area, and hence may be considered as characteristic of the coldest depths throughout the Indian Ocean, even into the Arabian Sea. The other unexpected species, *Amphiura atlantica*,

ranges from St. Helena, south-eastward to South Africa, where it has been taken on the southern coast only as far east as long. $18^{\circ} 33' E$. The extension of its range on the east coast northward to beyond Zanzibar is therefore surprising, but not at all incomprehensible.

SOUTHERN AREA OF THE ARABIAN SEA.

February 15th and 18th, 1934 :

St. 133 ; 3385 m. **Ophioplinthaca tylota**.

St. 135 ; 2727 m. *Amphiophiura trifolium*, *Ophiura irrorata*, *Homalophiura abyssorum* and **glypta**.

Excepting the cosmopolitan *Ophiura irrorata*, none of these species were taken in the central or northern areas of the Arabian Sea, but *Amphiophiura trifolium* was taken in deep water in the Zanzibar area. Geographically St. 135 is in the Maldive area, but bathymetrically it is obviously to be associated with the Arabian Sea. Hertz (1927) has already recorded *Homalophiura abyssorum* from the vicinity of the Maldives, although it was previously known only from off the West African coast. This strange distribution is like that of *Ophiocrates secunda* and can as yet be explained only by guessing, which is worse than no explanation at all. Whether the apparent difference between the faunas of the southern depths of the Arabian Sea and those to the north and north-west is a real one, or only due to our still very defective knowledge, is also only a guess.

MALDIVE AREA.

March 25th-31st, 1934 :

St. 139 ; 57 m. **Ophiactis spinulifera**.

St. 140 ; 515-525 m. *Astrocera compar*, *Ophiacantha pentagona*.

St. 142B ; 37 m. **Amphiodia minuta**.

St. 143 ; 797 m. **Asteroschema lissum**, *Asteronyx loveni*, *Amphiura diomedea* and *nociva*, *Amphiophiura paupera*, *Ophiomusium elegans*, *Ophiopallas palmarum*.

St. 144 ; 31 m. **Ophiactis spinulifera**.

April 2nd-11th, 1934 :

St. 145E ; 494 m. *Ophiomusium elegans*.

St. 153 ; 256-293 m. **Ophiura lanceolata**.

St. 154 ; 457 m. *Placophiothrix aristulata*.

St. 155 ; 2259 m. *Amphiophiura trifolium*.

St. 157 ; 229 m. **Ophiomæris parva**, **Ophiacantha nudextrema**, *Placophiothrix aristulata*.

St. 158 ; 786-1170 m. **Ophioplinthaca papillosa**, *Amphiophiura paupera*, *Ophiocrates secunda*, *Ophiernus adpersum*.

St. 159 ; 914-1463 m. **Ophioplinthaca papillosa**.

St. 162 ; 1829-2051 m. *Ophiolimna antarctica*.

St. 164 ; 183 m. **Ophiactis hexacantha**, *Placophiothrix purpurea*, *Ophiocoma scolopendrina*, *Ophionereis porrecta*.

Of the 24 species, one-third were hitherto unknown, and 6 of these were taken only in the Maldives ; one other was taken in the Gulf of Aden, and another in the Red Sea. Apparently these novelties do not extend across the deeps of the Arabian Sea to the

African coast. Of the other 16 species 2 were taken by the "Mabahiss" in the Maldive area only, but 1 is well-nigh cosmopolitan in deep water, and the other occurs in the East Indies. There is another nearly cosmopolitan form and 2 species are widespread in the Indo-Pacific region, while 7 others are typical East Indian forms. Of East African species, 2 were taken in the Maldives. There are then only 2 forms whose occurrence in the Maldives is extraordinary—*Ophiocrates secunda*, also taken in the Gulf of Aden, but known hitherto only from deep water off the West African coast, and *Ophiolimna antarctica* from the Antarctic area of the Indian Ocean.

This survey by areas and stations reveals clearly how essentially East Indian the fauna of the Arabian Sea is, for of the 68 previously-known species, 38 are typically East Indian, 5 others range widely throughout the whole Indo-Pacific area, and 7 others are more or less cosmopolitan in deep water. More than 70% of the ophiurans therefore occur in the East Indies. Of the remaining 18 species, 5 are South African (*Ophiacantha durbanensis*, *Amphiura atlantica*, *Ophiactis carnea*, *Macrophiothrix brevipeda*, *Ophionereis australis*), and 4 of these are shallow-water species. Their occurrence as far north as Zanzibar would not be surprising, but 4 of them reach the Arabian coast. Another group of 5 species are as yet known only from the "Mabahiss" collecting grounds; 2 of these (*Ophiothrix otiosa* and *Ophiothela caerulea*) are shallow-water species of the Arabian and Indian coasts, while the other 3 (*Amphiophiura trifolium*, *Ophiomusa ultima*, *Ophiopallas palmarum*) are deep water forms from the East African coast, *Ophiopallas* and *Ophiomusa* extending their range to the Maldives. Still another group of 3 species (*Ophiolimna antarctica*, *Amphiophiura sculptilis*, *Ophiernus vallincola*) are denizens of the Antarctic seas, though the last two occur also in very deep, cold water in the Pacific, and are probably more or less cosmopolitan in cold water deeps. The extension of their range into the Arabian Sea is therefore not surprising. The occurrence of the 5 remaining species, in the "Mabahiss" collections is sufficiently unexpected to warrant a word about each. The "Challenger" found *Ophiacantha cosmica* throughout the southern hemisphere, and it has since been found in the Panamic region and in the North Atlantic; it may fairly be listed with the cosmopolitan deep-water species just mentioned. The case of *Amphiura grandisquama* is more difficult to understand. It was first taken in the West Indian region in moderately deep water, and subsequently in the Philippines (Koehler, 1922, p. 159) in relatively shallow water. Then Mortensen (1933a and b) reported it from near St. Helena, and from off the coast of Natal. Now the "Mabahiss" finds it in the Gulf of Aden in moderately deep water. Such distribution is at present inexplicable. Mortensen (1933b, p. 354) says that it "might indicate" that the range "from the West Indies to the Philippine Seas is not now continuous", but even if that is granted, it is still a problem how it ever could have been continuous across the abyssal deeps of the Atlantic and Indian Oceans, since *grandisquama* has never yet been taken at a depth of over 1200 m. In *Ophiomusium validum* we have a somewhat similar puzzle. Discovered in the West Indies in 390–450 fms. by the "Challenger", this brittle-star has since been taken by both the "Investigator" and the "Siboga" in Indian and East Indian Seas at similar or somewhat greater depths, and now by the "Mabahiss" off Zanzibar. In *Homalophiura abyssorum* and *Ophiocrates secunda*, we have 2 additional species which were originally found in the Atlantic and now are known from the Gulf of Aden and the Maldives, but not from anywhere else. Both, however, are species of very deep cold water, and the possibility of a more or less continuous cosmopolitan distribution cannot be ignored.

Turning now to the bathymetrical distribution of the 102 species taken by the "Mabahiss", we find that disregarding 4 species from unknown stations, 29 species are littoral, occurring in less than 100 m., and 20 species are abyssal, occurring in depths greater than 2000 m. Exactly half the species therefore are from the continental slope. But if we consider this group more carefully we find more than half of them are really deep-water forms, occurring with but few exceptions only in depths of more than 1000 metres. The littoral species are chiefly in the families Amphiuridæ, 10 species, of which 6 are Ophiactis, and Ophiotrichidæ, 10 species, of which 5 are Placophiothrix.

As the result therefore of this study of the "Mabahiss" collections we may say that the ophiuran fauna of the Arabian Sea and the adjoining coasts has undoubtedly originated in the East Indian region, but has not yet developed nearly so rich a littoral group. There has been a considerable influx of cosmopolitan deep-water species and some Antarctic forms from the south, and with this apparently 2 or 3 Atlantic species have arrived, but this group has not materially affected the East Indian aspect of the fauna. Its most remarkable feature, emphasized by the "Mabahiss" collections, is the large proportion of endemic species which have been developed in this relatively small area. Only one-fourth of these occur in the Maldivé area (that is nearest to the East Indian region), and only 2 or 3 are abyssal forms. The southern Arabian coast, the Gulf of Aden and the East African area near Zanzibar have provided the conditions which have apparently favoured speciation. Of the new genera, 4 are from the Gulf of Aden and one from Zanzibar; the locality whence came the specimen upon which *Amphiomya* is based is unfortunately unknown.

In conclusion I wish to offer my sincere thanks to Lt.-Col. R. B. Seymour Sewell and the authorities of the British Museum for the privilege of studying this unusually interesting collection. While a large proportion of the specimens are in very poor condition, with most of the arms broken and the disks often crushed or missing, the labelling and packing is the best of any large collection I have studied. The poor condition is obviously due to the difficulties under which the dredging and trawling were done, but the excellence of the sorting and labelling bears witness to the care and thoroughness of the Director of the Expedition and the patience of all the workers. For the illustrations, Mr. Eugene N. Fischer is to be heartily thanked; his patience and care are beyond praise.

ANNOTATED LIST OF SPECIES.

Order **PHRYNOPHIURIDA.**

Family **OPHIOMYXIDÆ.**

OPHIOMYXA AUSTRALIS Lütken.

Ophiomyxa australis Lütken, 1869, pp. 45 and 99. H. L. Clark, 1915, p. 168; pl. 1, figs. 1 and 2.

Ophiomyxa brevispina von Martens, 1870, p. 249.

LOCALITY.—No label or clue. One specimen.

RANGE*.—Mauritius to Fiji; Japan to South Australia, in shallow water (littoral).

NOTES.—This single specimen, labelled only "Op 11", is 11 mm. across the disk,

* The given range is that known up to the date of the "Mabahiss" explorations. The extensions of range which her discoveries have made are thus more clearly emphasized.

but the arms are scarcely 30 mm. long. The skin of disk and arms, both above and below, is notably thick, completely concealing the plates and scales even in the dry condition, except in the interradian areas, where marginal plates are clearly in evidence. The arms are notably slender and the arm-spines short, flattened and blunt. The colour (dry) is a dingy, yellowish-white.

REMARKS.—Study of this specimen and comparison with a good series of *Ophiomyxa* from Australia, Japan, Mauritius, Fiji and the Caroline Islands, has convinced me that *brevispina* must be considered a synonym of *australis*. The present small specimen is far from typical.

OPHIOMYXA BENGALENSIS Koehler.

Ophiomyxa bengalensis Koehler, 1897, p. 363, pl. 9, figs. 70, 71; 1922, p. 17, pl. 5, figs. 5, 6.

LOCALITY.—Station 105; Zanzibar area; 310 metres. Two specimens.

RANGE.—China Sea to the Kei Islands, westward to the Andaman Islands and the coast of Natal, 250–550 metres.

NOTES.—The larger of the specimens is 20 mm. across the disk, with arms 125 mm. long. The smaller one is somewhat more than half as large. The colour, whatever it may have been, has entirely disappeared, leaving only the usual dingy light yellowish of alcoholic specimens.

REMARKS.—The numerous minute plates in the skin of disk and on the upper side of the arms are plainly visible in the dry condition, and, with the slender, acute arm-spines make the recognition of the species easy. The absence of plates at the periphery of the disk is also an important character.

Family TRICHAETERIDÆ.

ASTEROSHEMA LISSUM* sp. nov. (Text-figs. 1–3.)

LOCALITY.—Station 143; Maldives area; 797 metres. One specimen.

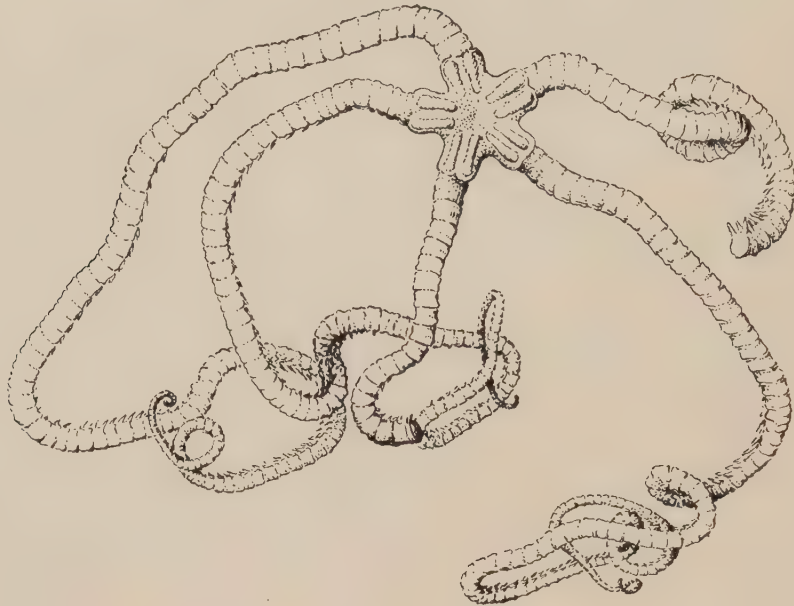
DESCRIPTION.—Disk 7.5 mm. in diameter; arms 5, about 110 mm. long, tapering distally to a very slender tip, more than twelve times the disk-diameter. Disk flat or slightly concave at centre, pentagonal but with the interradian sides deeply concave or notched. Radial shields narrow, straight and parallel, separated from each other by a shallow depression nearly as wide as the distal end of each shield. Surface of disk, including the radial shields, covered closely with very fine low granules, about 40–60 to a square millimetre near margin, but noticeably smaller at centre of disk and on proximal part of radial shields. Upper surface of arms strongly convex and covered with a granular coat like that of the disk; sides of arms more or less vertical with granular coat more sparse, but continuous to base of arm-spines; beyond the middle of the arms the granular coat becomes more and more sparse and distally the skin covering the arms is quite smooth and naked.

Interbrachial areas nearly 3 mm. high, the space between the long, obliquely placed genital slits, deeply depressed; granular coating evident but sparser than on disk; oral surface of disk and arms covered with naked, thin skin. First arm-pore without a

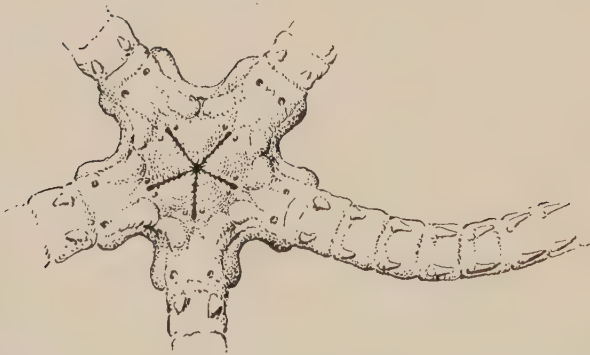
* λιστός = smooth.

protecting arm-spine. The following 8-10, with a single spinelet, shorter than, or finally equalling, the joint; succeeding pores with 2 spinelets, of which the outer is shorter than, or barely equals, the joint and is smooth, while the inner becomes two or three times as long, thickened and prickly at tip. Oral papillæ 3-5 on each side of the mouth slit, but very slightly differentiated, and in no case well defined. Teeth better defined, but

TEXT-FIG. 1.



TEXT-FIG. 2.



TEXT-FIG. 3.



TEXT-FIGS. 1-3.—*Asteroschema lissum* sp. nov. FIG. 1.—Entire specimen from dorsal side. $\times 2$.

FIG. 2.—Oral surface of disk and arm-bases. $\times 4$. FIG. 3.—Oral surface of part of arm, distally. $\times 4$.

not very large, more or less triangular and pointed at tip. Colour (dry) reddish white, lightest on the radial shields, darkest on the jaw tips and on the distal part of the arm-spinelets.

REMARKS.—This is a poorly characterized species in an ill-defined genus. I have sought in vain to refer it to some known species. It is quite unlike the Indian Ocean species, *rousseauri*, to which I at first referred it, if de Lorient's careful description of that form is not to be ignored. It is even more unlike *flosculum* Alcock, another Indian form. It seems to be nearest to the Japanese species *hemigymnum* Matsumoto, but the body

form, radial shields and much less crowded granular coat prevent thus referring it. I therefore regretfully add another species to a genus, of which our knowledge is still very unsatisfactory.

ASTROCERAS COMPAR Koehler.

Astroceras compar Koehler, 1904, p. 158; pl. 22, fig. 5; pl. 30, fig. 9; pl. 32, fig. 3.

LOCALITY.—Station 140; Maldive area; 550 metres. One specimen.

RANGE.—Philippines and East Indies from Luzon to the Kei Islands. 204–385 metres.

NOTES.—This specimen has the disk about 17 mm. across and the arms, which are more or less intertwined and hence hard to measure, are about 125 mm. in length. The colour ranges from light brown to nearly white in the dried condition. There is no clue as to what it may have been in life. The tubercles on the radial shields are numerous (8–12) and not very large (·30–·80 mm. in diameter), nearly spherical and minutely rough. Those on the basal arm-joints are very similar; there are often 3 on each side of a segment, one being larger than the other two. The arm-spines and mouth-parts show no features worthy of note.

REMARKS.—The proportions of this individual are very near those of Koehler's original material, the arms being about eight times the disk diameter, whereas Döderlein (1927, p. 80) says that the arms are "10–11" times the disk diameter. This difference is probably due to the differences in the condition of the specimens measured, and to the difficulty of measuring the arms in preserved specimens with any accuracy. The occurrence of *compar* in the Maldive area is interesting, as the geographical range is thus extended far to the west.

ASTERONYX LOVENI Müller and Troschel.

Asteronyx loveni Müller and Troschel, 1842, p. 119; pl. 10, fig. 3–5.

LOCALITY.—Station 143; Maldive area; 797 metres. One specimen.

RANGE.—Well-nigh cosmopolitan, in 150–2500 metres.

NOTES.—As this species usually occurs in considerable numbers, where it is found at all, it is curious that only a single specimen occurs in the present collection. This one is still quite young, but 11 mm. across the disk, with the arms not over 100 mm. long.

REMARKS.—Although Koehler (1904, p. 74) lists this species as being taken by the "Investigator" in the deep waters of the Indian Ocean, he gives neither a locality nor the depth. It is probable that the present record extends the known range considerably to the north-west.

Order **LÆMOPHIURIDA.**

Family **HEMIEURYALIDÆ.**

OPHIOMÆRIS PARVA* sp. nov. (Text-figs. 4 and 5.)

LOCALITY.—Station 157; Maldive area; 229 metres. Ten specimens.

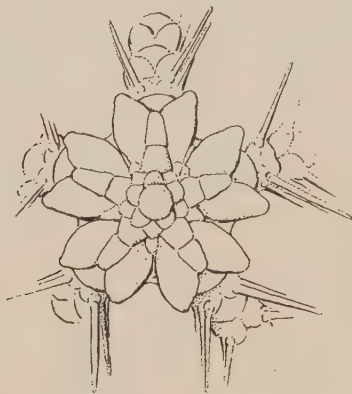
DESCRIPTION.—Disk, 3 mm. in diameter; arms 5, each about 9 mm. long, relatively stout at base, but tapering to a slender tip. Disk flat, conspicuously 5-lobed, each lobe

* *parvus* = small.

covered for the most part by a pair of radial shields, whose rounded distal angles, separated by a triangular plate with a straight outer margin, cause the lobe to appear abruptly truncate over the base of each arm; a conspicuous circular central plate, 4 or 5 low and wide, more triangular plates in each radius, and 3-5 small or very minute plates in each interradius, cover the rest of the upper surface of the disk. Radial shields relatively large, nearly a millimetre long and almost half a millimetre wide, apple-seed-shaped, with the wider end distal, nearly in contact at middle, but well separated at the ends. Upper arm-plates small but very distinct, rounded triangular; the basal ones are twice as wide as long, but they soon become more nearly equilateral.

Interbrachial areas below very small, covered by two or three minute plates between the large and nearly vertical genital scales; genital slits small, but relatively conspicuous. First under arm-plate relatively big, longer than wide, noticeably wider proximally than distally; succeeding plates much wider than long, rounded diamond-shaped, becoming very small distally. Side arm-plates large, not conspicuously projecting even at the more evident distal margins, meeting broadly on both the upper and lower surface of the

TEXT-FIG. 4.



TEXT-FIG. 5.



TEXT-FIGS. 4, 5.—*Ophiomœris parva* sp. nov. FIG. 4.—Dorsal view of disk. $\times 10$. FIG. 5.—Side view of 3 basal arm-segments. $\times 15$.

arm. Each plate carries 6 (or 5) opaque, bluntly-pointed arm-spines, which are not at all thorny, but are not perfectly smooth; the series on the first arm-segment (distal to disk) meet more or less completely in the midline above, and the uppermost spine of each series is much elongated, equalling the first 3 arm-segments; the second spine is much shorter, but is relatively long, while the following spines are successively shorter, the lowest being much shorter than the segment. On the following segments the uppermost spine is not so disproportionately big, hardly as long as the segment. Tentacle-scale small, thick and pointed. Oral shields diamond-shaped, wider than long, rather large and slightly swollen; adoral plates very large, broadly in contact in front of oral shield, but separated radially by the first under arm-plate. Oral papillæ 3 on each side of each jaw, the outermost widest, the innermost narrowest and most pointed. Colour of dried specimens greyish white, darkest on disk, lightest on oral surface of arms distally.

REMARKS.—Although there can be little doubt that this ophiuran is an *Ophiomœris*, it is easily distinguished from the other members of the genus by the strikingly different arm-spines. The absence of granules on the disk is also noticeable and there are other

differences in the oral shields and under arm-plates. It is hard to see why Koehler, who established the genus *Ophiomæris* and described and figured its type species, *spinosa*, should have published such an inaccurate and misleading figure of the dorsal surface of his new species (1904, pl. 4, fig. 1), or why he should have described the dorsal surface as covered by "plaques nombreuses, inégales, arrondies". There are now in the Museum of Comparative Zoölogy two of Koehler's specimens, co-types, and the dorsal surface is covered chiefly by the radial shields with relatively few, rather thick and often angular or irregular plates. The figure given is even more misleading for the radial shields of the co-types are nearly in contact radially at the middle, and each pair covers a radial "lobe", comprising one-fifth of the disk. Misled by Koehler's figure, I (1911, p. 250) considered that Lyman's *Ophioceramis obstricta* (1882, p. 26, pl. 11, figs. 1-3) could not be congeneric with *spinosa*, and I therefore established a new genus *Ophiurases* for it. Matsumoto, however, (1917, p. 139) detected my blunder and assigned my new name to the synonymy of Koehler's genus—a course subsequently endorsed by Koehler himself.

Ophiomæris therefore is apparently a genus of six species, *spinosa* Koehler, *obstricta* Lyman, *clausa* Lyman, *projecta* Matsumoto, *tenera* Koehler, and the here-described *parva*. Lyman's *clausa* is, however, quite different from the others and had best be made the type of a new genus, for which I suggest the name *Ophiocyclus*.* It resembles *Ophiomæris* in the general character of the oral frame and in the small upper and under arm-plates, but the disk is flat, perfectly circular with no radial "lobes" so marked in *Ophiomæris*, and large interbrachial areas below with a single plate covering nearly all of each. The very slender upper arm-spines are also quite different from those of *Ophiomæris*. Lyman's description and figures (1882, p. 26, pl. 11, figs. 4-6) are admirable, as re-examination of one of his types shows.

The ten specimens of *Ophiomæris parva* in the present collection are very much alike, having the disk 2-3 mm. across, and the colour more or less nearly white, in rather evident contrast to the fragments of a pale grey sponge to which four of them still cling very closely. It is obvious that all of them were taken from a branching sponge (one or more), upon the more slender branches of which they were living. For such a life they are structurally well adapted.

Family OPHIACANTHIDÆ.

OPHIACANTHA ABNORMIS Lyman.

Ophiacantha abnormis Lyman, 1879, p. 59; pl. 15, fig. 411-413.

Ophiacantha gratiosa Koehler, 1897, p. 346; pl. 8, figs. 60, 61.

LOCALITY.—Station 54; South Arabian coast; 1046 metres. Fifteen specimens.

RANGE.—Philippine Islands westward to Laccadive Islands, 347-1260 metres.

NOTES.—These specimens are for the most part in such poor condition, they add but little to our knowledge of the species. They range in size from 9 to 16 mm. across the disk, and the arms when most nearly complete are about three times the disk diameter, but the attenuate terminal portion is constantly lacking. The colour (dry) is a quite indistinctive light grey or greyish white. The label gives the depth at which they were taken as 952 metres, but in the station list Station 54 is recorded as having a depth of 1046 metres.

* *Ophio* + κύκλος = a circle, in reference to the very definitely circular disk.

The inconsistency is not important, however, as the "Challenger" took the original specimens at 675–1260 metres.

REMARKS.—Koehler (1897) decided that the Ophiacanthas collected by the "Investigator" which resembled *abnormis* were not identical with the "Challenger" species, and hence he described them under the name *gratiosa*. Comparison of some of his type material with that of Lyman shows, however, that he was misled by Lyman's poor figures and by his own unwillingness to allow for individual diversity. There is no doubt that *abnormis* and *gratiosa* are identical. The species *inutilis*, taken by the "Siboga" is very similar, but comparison of one of Koehler's types with the other material at hand seems to justify keeping them apart, at least until larger series of specimens are available.

OPHIACANTHA AMELETA H. L. Clark.

Ophiacantha amelea H. L. Clark, 1938, p. 209.

Ophiacantha dallasii Döderlein, 1896, p. 291; pl. 14, figs. 3a–c; pl. 16, figs. 12, 12a.

LOCALITY.—Unknown. No label with the single specimen but "Op. 11".

RANGE.—Northern Australia, East Indies and Philippines, in shallow water (littoral).

NOTE.—The disk is about 2 mm. across, and the arms are all broken, but three have only the terminal part missing. The colour (dry) is nearly white. The large spines on the second arm-segment are conspicuous, so that the identification is reasonably sure.

REMARKS.—As was pointed out in my Australian Report (1938) Döderlein and Koehler confused this small tropical Ophiacanthid with a Korean species named by Duncan in 1879, which has very different arm-spines. It is regrettable that there is no clue as to the locality where the present specimen was taken, for its occurrence in the north-western Indian Ocean is a notable extension of its range.

OPHIACANTHA COSMICA Lyman.

Ophiacantha cosmica Lyman, 1878, p. 146; pl. 10, figs. 251–254.

Ophiacantha aculeata Verrill, 1885, p. 547. Koehler, 1914, p. 74; pl. 11, figs. 1, 2.

LOCALITY.—Station 120; Zanzibar area; 2926 metres. One specimen.

RANGE.—Widespread in very deep water (590–4018 metres) in the southern hemisphere, in the Panamic region, and in the North Atlantic.

NOTES.—This specimen is a large one, about 16 mm. across the disk, but it is in very poor condition, owing apparently to the rough handling in the trawl. The arms are all broken, only one exceeding 50 mm. in length. The arm-spines and upper arm-plates are more or less broken, very few showing the normal appearance, and the disk spinelets are mostly rubbed off. The colour (dry) is nearly white, but has a yellowish tinge.

REMARKS.—This Ophiacanthid has not been previously reported in the Indian Ocean, but there is good reason for believing that it is nearly cosmopolitan in the abyssal region. A specimen in the Museum of Comparative Zoology, taken in the North Atlantic, south of Marthas Vineyard in 1394 fathoms ("Blake" Station 340; 1880), carries a note in Lyman's handwriting—"5–7 smooth spines while *millespina* has 7–8. Upper arm-plates also different. *O. cosmica*?" But Mr. Lyman never published anything about this specimen, which is first listed in my 'Catalogue of Recent Ophiurans' (1915, p. 197), under the name *Ophiacantha cosmica*, comparison with specimens of *cosmica* of similar size

(10–12 mm. across the disk) from off the coast of Peru in 2222–2338 fms., showing that there is no adequate reason for calling them by different names. In 1885, however, Verrill had named the Atlantic form *aculeata*, and in 1914 Koehler published two excellent photographs of one of Verrill's original specimens. Neither Verrill nor Koehler make any reference to *cosmica*, apparently assuming, quite naturally, that a southern Pacific species would not occur in the Northern Atlantic. This conclusion has been generally accepted by later writers, but apparently it is incorrect, and *cosmica* must be recognized as a more or less cosmopolitan, abyssal Ophiacantha.

OPHIACANTHA DURBANENSIS Mortensen.

Ophiacantha (Ophiotreta) durbanensis Mortensen, 1933a, p. 324, figs. 44a, b; pl. 19, figs. 13–15.

LOCALITY.—Station 24; Gulf of Aden; 73–200 metres. One specimen.

RANGE.—Natal, off Durban, 225 fms. (405 metres).

NOTES.—This specimen is a very young Ophiacanthid only 3.5 mm. across the disk. The arms are all broken, but in life could hardly have exceeded 15 mm. The disk is covered sparsely with rough, pointed granules, a very few of which are sufficiently elongated to be called spiniform. Excepting the basal 3 or 4, the under arm-plates are longer than wide, and have a nearly straight distal margin. The oral shields are wider than long and there are 6 or 7 oral papillæ on each side of each jaw. The colour (dry) is pale brownish yellow or dirty white.

REMARKS.—In spite of the differences just mentioned it seems better to refer this little Ophiacantha to Mortensen's South African species, which it resembles in the upper arm-plates, spines, oral armature and tentacle-scales, than to identify it with the Japanese species *bisquamata* Matsumoto. It would not be justifiable to base a "new species" on so young and imperfect a specimen.

OPHIACANTHA PENTAGONA Koehler.

Ophiacantha pentagona Koehler, 1897, p. 342; pl. 8, figs. 56 and 57.

LOCALITIES:

Station 24; Gulf of Aden; 73–200 metres. Five specimens.

Station 25; Gulf of Aden; 620 metres. One specimen.

Station 42; South Arabian Coast; 1415 metres. Two specimens.

Station 45; South Arabian Coast; 38 metres. Three specimens.

Station 140; Maldives area; 515–525 metres. Seven specimens.

RANGE.—Sagami Bay, Japan, southward to the Kei Islands and westward to the Andaman Islands, 81–1698 metres.

NOTES.—These specimens are, with few exceptions, in very poor condition and are mostly immature. Their identification is therefore in many cases open to question, but only in the case of the two specimens from Station 42 do I feel any serious doubt. These individuals are scarcely 5 mm. across the disk, and the seemingly short arms are much twisted, curled inwards and broken. The disk covering is made up of lower, coarser and fewer spinelets than usual, there are as a rule, 4 oral papillæ on each side of each jaw, and the colour (dry) is light yellowish or nearly white.

OPHIACANTHA VORAX Koehler.

Ophiacantha vorax Koehler, 1897, p. 353 ; pl. 8, figs. 68 and 69.

LOCALITIES:

Station 26 ; Gulf of Aden ; 2312 metres. Eight specimens.

Station 62 ; Northern Area of Arabian Sea ; 1893 metres. One specimen.

RANGE.—Celebes and Kei Islands to Cape Comorin, India, 1788–2029 metres.

NOTES.—In spite of the rather poor condition of these specimens, there is no apparent reason for doubting that they belong to the same species as the “Investigator” *Ophiacantha* to which Koehler gave the name *vorax*. They range from 5 to 8 mm. across the disk, and the arms are about six times that. But as the arms are quite attenuate and the terminal part is usually lacking, it is probable that they are in life fully eight times the disk diameter, as Koehler says in his original description. The colour of the specimens (dry) at hand is dirty whitish or very pale grey brown.

REMARKS.—Koehler (1922) discussed the relationship of this species to some of its near allies, but material is still inadequate for a final decision on the questions of synonymy in the group.

OPHIACANTHA NUDEXTREMA* sp. nov. (Text-fig. 6.)

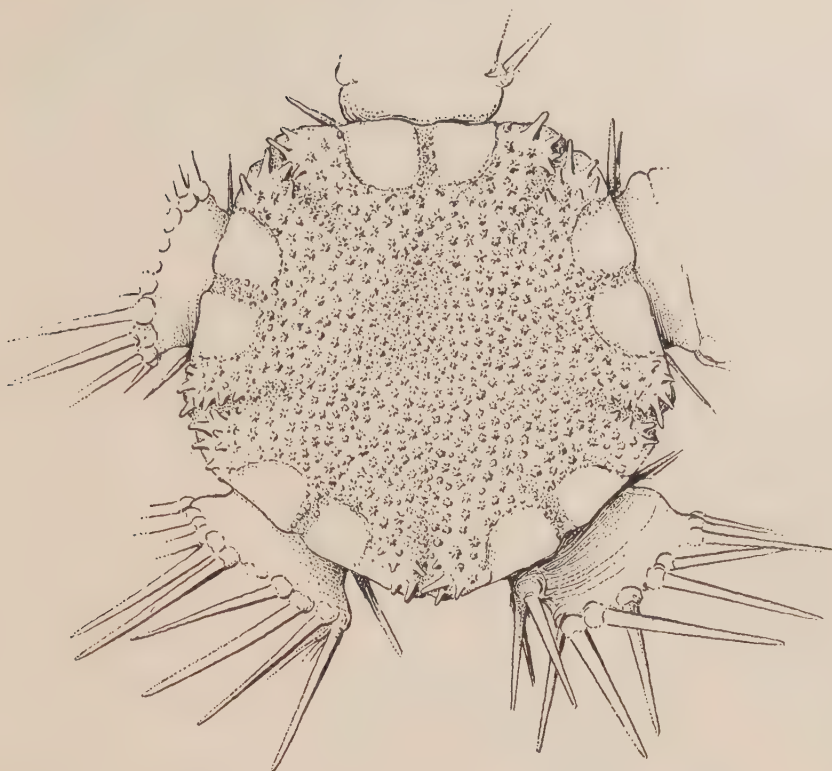
LOCALITY.—Station 157, Maldive area ; 229 metres Six specimens.

DESCRIPTION.—Disk 3 mm. in diameter ; arms 5, each about 14 mm. long, slender, tapering, more or less moniliform, and curled inward or twisted. Disk nearly circular, but more or less decagonal, flat or slightly concave, covered (but not densely) with low, rather thick “stumps”, which are truncate and thorny at tip ; very commonly the tip is trifid, and each of the three branches ends in several low teeth. On the interradian corner of each radial shield the stumps tend to become distinct blunt spinelets without thorns. Radial shields elongated triangular, for the most part concealed, as are the disk-scales, by the thorny stumps, but the distal ends, excepting the interradian corners, are conspicuous, thick, bare, and concave at the margin. Upper arm-plates small, triangular, somewhat convex, widely separated from each other by the big side arm-plates, their distal margin nearly straight or a little convex ; the length scarcely exceeds the breadth.

Interbrachial areas below small, bare, with very large genital slits and a few short thick stumps close to the disk margin. First under arm-plate nearly square, with somewhat rounded corners ; second plate broadly triangular, much wider than long ; succeeding plates well separated by the side arm-plates, more or less pentagonal or increasingly bell-shaped, as long as wide or longer. Side arm-plates very large and conspicuous, meeting broadly both below and above, and projecting enough to make the arms moniliform ; they each carry 8 spines on the first segment distal to disk, the uppermost longest and equal to at least two segments ; the two series on this first segment are closely approximated dorsally ; on succeeding segments the rows do not so nearly meet, the number of spines dropping to 6 and then to 5. Spines slender, terete, nearly or quite smooth (rough or thorny when magnified 90×), but the lower ones may be slightly thorny, even under little magnification. Tentacle scale single, rather large, wide and pointed.

Oral shields much wider than long, diamond-shaped with rounded angles ; madreporite more nearly pentagonal and about as long as wide. Adoral plates short, wide and

* *nudus* = naked + *extrema* = tips, in reference to the bare tips of the radial shields.



TEXT-FIG. 6.—*Ophiacantha nudextrema* sp. nov. Dorsal view of disk. $\times 20$.

thick, their outlines rather indistinct; they seem to meet more or less fully proximal to the oral shield. Oral papillæ 3 (rarely 4) on each side of each jaw, thick and pointed. They are minutely rugose like the lowest tooth, which they resemble, though it is distinctly larger. Colour of dried specimens nearly white, but with more or less of a pearl-grey tinge.

REMARKS.—Although all of the specimens are in poor condition, there seems no reason why they should not be referred to *Ophiacantha*, but I find no species in that genus to whose description they answer. Apparently related to *pentagona*, they are readily distinguished by the character of the disk, a feature that separates them also from other species of the same small size and general character.

OPHIOTHAMNUS LONGIBRACHIUS* sp. nov. (Text-fig. 7.)

LOCALITY.—Station 54; South Arabian coast; 1046 metres. One specimen.

DESCRIPTION.—Disk missing, but the scar on the arm bases shows that it was little more than 2 mm. across; the scaling and the character of the radial shields are, of course, unknown. Arms 5, each about 40 mm. long, very slender and strongly moniliform. Upper arm-plates small and widely separated, convex, triangular, much wider than long; basally and even distally the width seems to exceed the length.

Interbrachial areas missing. Under arm-plates of moderate size, longer than wide, widest distally and more or less bell-shaped, well separated. Side arm-plates large and projecting, meeting above and below. Arm-spines slender, terete, translucent and nearly

* *longus* = long + *brachium* = arm, in reference to the extremely long arms.

or quite smooth ; on the basal joints there are 7 or 8 on each side and the series are closely approximated in the mid-dorsal line ; the uppermost spines are fully equal to three arm segments ; the lowest scarcely exceed one. Distal to the fifth or sixth segment, the uppermost spines are shorter and the series are no longer closely approximated, but the change, though well-marked, is not abrupt. Tentacle-scale single, slender and acute. Oral shields small, very long and narrow, sharply pointed at the inner end, but more rounded distally ; the width is scarcely half the length. Madreporite somewhat swollen distally. Adoral plates relatively large ; each one is larger than the oral shield ; inner ends narrow and more or less evidently in contact ; outer ends wider and truncate. Oral papillæ 3 on each side, the outermost very low and wide, nearly equalling the adoral plate which it adjoins ; the middle papilla is flat and truncate, and the innermost, a little narrower, may be more or less pointed, but is relatively wide and blunt. Teeth very large, flattened and wide at tip, which is usually more or less notched, and may show a central point or two. Colour (dry) white.

REMARKS.—In spite of its defective condition there is no room for doubt of the generic position of this brittle-star, for its relationship to the genotype, *O. vicarius* Lym., is beyond



TEXT-FIG. 7.—*Ophiothamnus longibrachius* sp. nov. Lower surface of oral frame. $\times 25$.

question. A number of small Ophiacanthids in which the disk and general appearances suggest *Ophiothamnus* have been referred to the genus, but their mouth parts are so unlike those of *vicarius*, they should not be retained in the genus. This Maldive Island specimen has the characteristic features of the mouth-parts well marked, but at the same time the very long and slender arms and extraordinarily narrow oral shields distinguish it at once from any of the previously known species, so that I have no hesitation in giving it a name. Obviously it is a pity, however, that so interesting a species of a genus not hitherto known from the Indian Ocean, should be based on a single defective individual.

OPHIOLINTHACA RUDIS (Koehler).

Ophiomitra rudis Koehler, 1897, p. 358 ; pl. 9, figs. 74, 75.*

Ophiomitra cardiomorpha H. L. Clark, 1911, p. 179, fig. 81.

Ophiolinthaca rudis Koehler, 1904, p. 132.

Ophiolinthaca cardiomorpha H. L. Clark, 1915, p. 210.

LOCALITIES:

Station 108 ; Zanzibar area ; 786 metres. One specimen.

Station 119 ; Zanzibar area ; 1207–1463 metres. Three specimens.

Station 184 ; Gulf of Aden ; 1270 metres. One specimen.

*Not figs. 75 and 76 as given on p. 358.

RANGE.—Omai Saki, Japan, southward to Timor, and westward to the Maldive and Laccadive Islands, 650–1316 metres.

NOTES.—These five specimens range from 10 to 14 mm. in disk diameter and show but little diversity. The specimen from the Gulf of Aden has more slender spinelets on the disk and the upper arm-spines seem unusually long and slender; in this individual the arms are nearly complete and almost straight, and measure fully 60 mm. in length. The other specimens are coarser and the arms are distinctly stouter and more or less incurved towards the mouth, but only in the smallest specimen are they almost complete. The colour of all (dry) is nearly white.

REMARKS.—The unfortunate typographical error by which “figs. 75 et 76” are said to represent *rudis*, in connection with the original description, misled me when I was preparing my report on North Pacific ophiurans (1911), and the figures published later (1899, pl. vii, figs. 58, 59) are still too diagrammatic to make the species recognizable. As a consequence, the Japanese specimens were described as a new species under the name *cardiomorpha*. When, however, Koehler published his admirable photographic figures of *rudis* (1922, pl. 24, figs. 1–6), the identity of the Japanese species with his was established, and comparison of a “Siboga” specimen with a co-type from Japan leaves no room for doubt. It is a little surprising that Koehler did not himself detect this identity, for in his “Albatross” report (1922) he has been critical of a number of other Japanese forms which I considered “new”, and his views are in general well-founded. The extension of the range of *rudis* to Zanzibar and the Gulf of Aden is very interesting.

OPHIOPLINTHACA CRASSA* sp. nov. (Text-figs. 8 and 9.)

LOCALITY.—Station 118; Zanzibar area; 1789 metres. One specimen.

DESCRIPTION.—Disk 14 mm. in diameter, nearly flat, but a little concave near centre; radial wedges well marked, elevated but little above arm-bases, covered chiefly by their flat radial shields and half a dozen overlapping, coarse disk-scales on the interradyal margin of each; proximal portion of each wedge covered, like the centre of disk, by numerous, irregularly rounded scales; on a single one of these scales is a low, cylindrical tubercle of small size, but otherwise the disk bears no projections; radial shields about 2.5 mm. long by 2 mm. wide, either slightly separated by a long narrow scale distally, or more or less in contact there. Arms 5, all broken, but noticeably stout, 4 mm. wide (without spines) and 3 mm. high basally; apparently about 70 mm. long in life. Upper arm-plates as usual in typical species of the genus, much wider than long, widest at distal margin, which is slightly convex; lateral margins curve inwards at first slowly, then abruptly to the mid-line, where they meet in a more or less evident point; first two plates in contact rather broadly, but subsequent plates separated by the side arm-plates meeting in mid-dorsal line.

Interbrachial areas below moderately large, not markedly contracted at oral shield, covered with rather numerous scales; occasionally one of these scales bear a short, smooth, club-shaped spinelet; genital slits not noticeably widened. First two under arm-plates much wider than long, with slight anterior and posterior projections and long narrow lateral wings; they are in contact at the thickened anterior and flat posterior median projections, but otherwise are well separated from each other; the following plates are

* *crassus* = coarse, in reference to its broad, stout arms.

more broadly in contact and are somewhat wider, especially on the distal side; from the sixth plate on, they become nearly as wide proximally as distally, and are more or less quadrangular, but the distal margin is convex, more or less thickened near middle and often has a distinct notch there. Side arm-plates stout and projecting laterally; they meet very narrowly above and below except at the base of the arm, where they are quite separated on the first two or three segments; at the middle of the arm each carries a series of 4 short, stout, but fragile, thorny arm-spines, the lowest is shortest and equals two segments, but the uppermost is not much longer; on the basal segments there is a fifth spine, and on the first two or three a sixth and even a seventh is present; owing to the poor condition of the specimen it is impossible to determine the form and relative length of the uppermost spines. Tentacle-scales more than a millimetre long, nearly a

TEXT-FIG. 8.



TEXT-FIG. 9.

TEXT-FIGS. 8, 9.—*Ophioplinthaca crassa* sp. nov. FIG. 8.—Dorsal view of half of disk. $\times 5$.FIG. 9.—Oral view of same. $\times 5$.

millimetre wide basally, very thick, somewhat triangular, bluntly pointed on the first two or three segments; on succeeding segments, they are less stout and have slender points but they decrease little in length. Oral shields definitely pentagonal, with rounded angles and thickened margins, about as long as wide; distal lateral margins concave; madreporite not noticeably bigger than the others. Adoral plates short and wide, meeting broadly within. Oral papillæ crowded, 5 on each side, the distal ones low and wide, the proximal 3 narrower and more pointed. Teeth long, stout and pointed. Colour of dry specimen nearly white.

REMARKS.—The poor condition of this specimen is apparently due to the rough journey in the dredge from the great depth at which it was taken. All the arm-spines excepting some of the lowest are broken or have been pulled off, as a result of which the actual appearance of the arms in life cannot be pictured, but not even the basal series were at all nearly approximated dorsally. The species is well set apart from its near relatives by the broad, rounded radial shields, the absence of tubercles or thorny stumps or spinelets on the disk, the definitely pentagonal oral shields and the very stout tentacle scales. The stout thickened arms are also a good character when it is compared with any of the other *Ophioplinthacas* taken by the "Mabahiss".

OPHIOLINTHACA PAPILLOSA* sp. nov. (Text-figs. 10 and 11.)

LOCALITIES:

Station 158 ; Maldive area ; 786–1170 metres. Two specimens.

Station 159 ; Maldive area ; 914–1463 metres. Five specimens.

Station 184 ; Gulf of Aden ; 1270 metres. One specimen.

DESCRIPTION.—Disk 10 mm. in diameter, deeply concave at centre, but more than 3 mm. high at margin ; the radial wedges of which it is largely made up are over a millimetre higher than the arm-bases, and are more than 5 mm. wide. Centre of disk covered by small and ill-defined scales which are, for the most part, quite concealed by the thorny stumps they bear ; these stumps are about half a millimetre high and vary considerably in thickness ; if rather slender they usually terminate in 3 very sharp teeth or thorns ; but if rather stout, the thorns are shorter and more numerous (4–6), and are not all in the same plane, only one or two being actually terminal ; these stumps are most numerous on the central portion of the disk, but a few are scattered on the proximal part of each radial wedge and even in the furrows between them. Each radial wedge is covered by two large radial shields, 3 mm. long by 1.5 mm. wide (distally), broadly in contact except at the proximal end, and 12–15 thin flat plates of very diverse sizes, the largest lying dorsally in contact with the radial shields. At the outer end of each wedge there is a nearly vertical area, some 2 mm. wide and more than a millimetre high, the lateral portions of which are formed by the genital plates ; the central portion bears about 20 papillæ decidedly smaller than the disk-stumps and much less thorny ; the uppermost papillæ are borne on the distal corners of the radial shields, while the lowest are actually located on the upper surface of the arm-base itself. Arms 5, all broken, but apparently at least 50–60 mm. long in life ; they are 2.5 mm. wide. Upper arm-plates well separated from each other even basally, broadly bell-shaped, with a convex distal margin and a pointed inner end ; the lateral margins are concave distally, but become convex near the point.

Interbrachial areas below are small and covered with a few flat plates ; genital slits wide, especially proximally, where they cause the area to be connected with the oral shield by a very narrow neck. Under arm-plates well separated from each other, wider than long ; proximal margin nearly straight, but proximal surface of plate is a little concave ; distal margin, noticeably longer than proximal, only a trifle convex, but distal surface of plate is noticeably swollen ; lateral margins a little concave. Side arm-plates large, meeting noticeably both above and below ; each carries a series of 7 spines which do not approximate dorsally, even on the basal arm-segments. Uppermost spine or the one below it longest, equalling 3 segments ; these spines are very delicately thorny, at least near base ; the following spines are more thorny and successively shorter, but even the lowest exceeds the arm-segment. The thorniness of the spines is scarcely visible except on magnification of 8 to 10 times. Tentacle-scales single, large, flat, pointed, about as long as under arm-plate and 3 times as long as wide. Oral shields wider than long, diamond-shaped, the two distal margins noticeably thickened ; the madreporite is more pentagonal as the distal angle is widened and rounded. Adoral plates short and very wide, meeting broadly within, where they are nearly as wide as at the outer end. Oral papillæ only 3 (rarely 4) on each side, almost subequal ; they are thick, narrow and pointed,

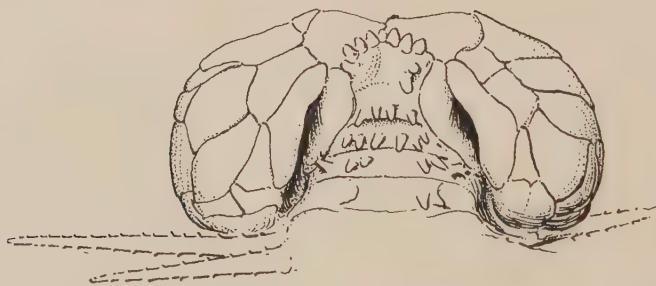
* *papillosus* = bearing papillæ, in reference to the groups of papillæ at the base of each arm.

the innermost is a bit the longest, the outermost somewhat wider and blunter. Lowest tooth like the innermost papilla, but much larger. At the outer end of each mouth-slit, around the tentacle-pore there is some trace of granulation, but there is no heap of granules as in some members of the genus. Colour of dry specimen, white, the arms and spines a trifle more yellowish than disk.

TEXT-FIG. 10.



TEXT-FIG. 11.



TEXT-FIGS. 10, 11.—*Ophioplinthaca papillosa* sp. nov. FIG. 10.—Dorsal view of half of disk. $\times 10$.

FIG. 11.—View of distal end of radial wedge and upper surface of base of arm. $\times 10$.

REMARKS.—The large holotype is a very typical *Ophioplinthaca*, but it is certainly not *rudis*, although it was taken at the same station with an adult example of that species. The disk covering and the oral papillæ distinguish them at a glance. I have sought in vain among the 25 or more species of *Ophioplinthaca* that have been named to find one to which I might refer this specimen, but the combination of ophiacanthid oral papillæ with a very typical ophioplinthacoid disk, the narrow but large tentacle-scale, and the low thorny disk-stumps make a unique combination so far as I can see, while the striking

group of papillæ on the distal end of each wedge of the disk is very distinctive. It is true such papillæ occur in some other typical Ophioplinthacas, but in no other species is the group so conspicuous.

The specimens of Ophioplinthaca from Stations 158 and 159 are all young, with disks ranging from 5 to 7 mm. in diameter. In the two specimens from 158 the characters are all essentially the same as in the holotype, but the smaller specimens from 159 show very few, if any, papillæ distal to the radial wedges, and the arm-spines are shorter and more thorny. These differences are undoubtedly those of youthfulness, and there is no doubt that all the specimens are identical with the large individual from Station 184.

*OPHIOPLINTHACA TYLOTA** sp. nov. (Text-figs. 12 and 13.)

LOCALITY.—Station 133 ; southern area of Arabian Sea ; 3385 metres. Five specimens.

DESCRIPTION.—Disk 14 mm. in diameter, flat, but a little concave near centre ; radial wedges large and evident, but notches between them not very deep, reaching scarcely half-way to disk-centre ; wedges but little elevated above arm-bases. Radial shields long wedge-shaped, rather narrow and a little depressed, in contact distally, but well separated within. Remainder of radial wedges and central portion of disk covered with numerous overlapping scales of diverse forms and sizes ; the largest are on the distal lateral portions of the radial wedges. On two or three of these large scales on each wedge, a knob-like tubercle is to be found of a very characteristic form ; when young (apparently) these tubercles are spherical and sessile, but the typical ones are bud-like with a short stalk which merges into the ellipsoid tubercle itself ; they are a millimetre or more in length and about .60 mm. in diameter ; often they are incomplete, the distal end remaining open like a cup or, more rarely, like a shallow bowl. Arms 5, all more or less broken ; the most nearly complete is about 55 mm. long, 3 mm. wide at base, and 2 mm. high ; the complete arm probably exceeded 70 mm. Upper arm-plates of the usual Ophioplinthaca form, much wider than long, with a convex distal margin and the convex lateral margins meeting in a proximal point in the midline ; this point is not quite in contact with the distal margin of the previous plate. The surface of the plate is not evenly arched or rounded, but comes to an elevated but low, blunt or truncate point, just proximal to the centre ; this elevation is not conspicuous, but gives a characteristic facies to each plate ; the first two plates are broadly in contact, but, as already stated, the following do not quite touch.

Interbrachial areas below relatively large, quite wide even at the junction with the oral shield, fully covered with coarse, overlapping scales, the distal ones the largest scales in the whole interradial area ; genital slits narrow. Under arm-plates very much wider than long ; proximal portion very narrow, expanding abruptly beyond the tentacle-pores into pointed wing-like processes which nearly reach the sides of the arm ; distal margin of plate 2.5 mm. long, nearly straight, with a conspicuous knob at its middle ; the narrow flat proximal part of the plate with this knob just distal to it is a striking specific character. Side arm-plates of moderate size, meeting narrowly above and below, except at very base of arm ; on the distal half of the arm they meet broadly both above and below ; at tip, the arm is probably somewhat moniliform. On the basal part of the arm each side arm-plate carries 6 rather thick but fragile hollow spines, the uppermost or the one below it

* *τυλωτός* = knobbed, in reference to the knobs on the disk.

being longest and usually largest; it may equal 3 arm-segments, while the lowest spine little exceeds 1—the spines are quite thorny, especially the lowest ones; the uppermost is sometimes nearly smooth; the series of spines encroach but little on the upper side of

TEXT-FIG. 12.



TEXT-FIG. 13.



TEXT-FIGS. 12, 13.—*Ophioplinthaca tylota* sp. nov. FIG. 12.—Dorsal view of half of disk. $\times 6$.

FIG. 13.—Oral view of radial wedge and base of arm. $\times 6$.

the arms. Tentacle-scales very thick, heavy and smooth on the basal segments, but they become smaller, flatter and very thorny further out.

Oral shields pentagonal, the inner margins thin and straight, the outer ones conspicuously thickened and curved, the outer, lateral margins deeply concave, the distal

margin convex ; inner angle sharp, the others rounded. Adoral plates large, flat, quadrilateral, meeting broadly within. Oral papillæ only 4 (rarely 3) on each side, rather small, but thick and sharp-pointed. Teeth somewhat larger, thick and bluntly pointed. Colour (dry) silvery white on disk, a more yellowish white on arms.

REMARKS.—Considering the great depth from which these three specimens were taken their condition is very good. The two paratypes are about the same size as the one described, but the arms are more badly broken. They differ noticeably from the holotype in the number of bud-like tubercles on the disk. In one there are only 7, and all are relatively small and apparently immature. In the other there are more than 50, but they occur only on the distal or lateral margins of the radial wedges ; they vary much in size, but nearly all have the typical stalked ellipsoid form. This seems to be the best characterized of the new *Ophioplinthacas* taken by the “Mabahiss”, for aside from the curious disk tubercles, the under arm-plates and tentacle-scales are very characteristic.

OPHIOTRETA EXIMIA (Koehler).

Ophiacantha eximia Koehler, 1904, p. 116 ; pl. 21, figs. 3-5.

Ophiotreta eximia H. L. Clark, 1915, p. 216.

LOCALITIES :

Station 62 ; northern area of Arabian Sea ; 1893 metres. One specimen.

Station 184 ; Gulf of Aden ; 1270 metres. Three specimens.

RANGE.—Cagayan, Southern Philippines, south to Sumbawa and the Kei Islands, 233-1788 fms.

NOTES.—These are well-marked adults, 12-19 mm. across the disk. The largest from the Gulf of Aden has the arms exceeding 150 mm. and the upper arm-spines on the basal part of the arms are 10-12 mm. long ; as there are 10-12 spines on each side-arm plate, and the series approximate closely in the mid-dorsal line, the bristling appearance of this fine *Ophiacanthid* is very striking. The smallest specimen, from Station 62, is in very poor condition, and the arm-spines are for the most part broken or missing. Comparison of the material with a co-type of Koehler's from near Sumbawa, leaves no doubt as to its identity. The small specimen from Station 62 is a very pale brown or dirty white, but the large specimens from the Gulf of Aden have a distinctly purplish tint, especially the arm-spines. All the specimens are dry.

REMARKS.—The extension of range of *eximia* from the East Indies to the Gulf of Aden is notable, especially since it apparently was not met with by the “Investigator” anywhere in the Indian Seas.

OPHIOTRETA MATURA (Koehler).

Ophiacantha matura Koehler, 1904, p. 112 ; pl. 23, figs. 2-4.

Ophiotreta matura Koehler, 1922, p. 76 ; pls. 12, 13, 14 and 15, figs. 1-3.

LOCALITY.—Station 184 ; Gulf of Aden ; 1270 metres. One specimen.

RANGE.—Palawan and Eastern coast of Luzon, south to the Kei Islands, 239-4161 metres.

NOTES.—This is a well-preserved adult, 13 mm. across the disk, with arms 65 mm. long, or more. The disk is almost covered with a fairly dense coat of slender spinelets of

uniform length; the radial shields are completely concealed. The dry specimen is very light yellowish brown on the disk, while the arms have an evident purplish tinge.

REMARKS.—The occurrence of this apparently common and very variable species in the Gulf of Aden is a notable extension of its known range, but the occurrence of but a single specimen, and that at the same station with the closely related species *eximia*, is indeed remarkable. The only explanation, of course, is the extremely uncertain chances of dredging, especially in deep water. At Station 184 the length of the haul was 2 hours and 45 minutes, and the area covered may well have included some diversity of habitat, so that these two species of *Ophiotreta* were not necessarily closely associated in life. It may be worth noting, however, that the "Albatross" took the two species together at two stations, one in Molucca Passage, the other in Buton Strait.

OPHIOLIMNA ANTARCTICA (Lyman).

Ophiocomis antarctica Lyman, 1879, p. 44; pl. 14, figs. 380–382.

Ophiolimna antarctica Matsumoto, 1917, p. 95.

LOCALITIES:

Station 120; Zanzibar area; 2926 metres. One specimen.

Station 162; Maldive area; 1824–2051 metres. Eight specimens.

RANGE.—Extreme Southern Indian Ocean (near Prince Edward, Marion and Heard Islands), 90–270 metres.

NOTES.—The specimen from Station 120 is in very poor condition, but is undoubtedly identical with those from the Maldive area. The latter are also in poor condition, but are sufficiently well-preserved to show the essential characters of the species. Comparison with type-specimens of Lyman's species leaves no room for doubt that they are certainly *antarctica*. They measure 6–10 mm. across the disk, and the arms are apparently about four times as much or possibly more. The dry specimens are white.

REMARKS.—It is most interesting to find this Antarctic species in the "Mabahiss" collection. In the southern area, where first discovered, it lives in comparatively shallow water, but the bottom temperature was near 2° C.; at Station 120, the bottom temperature was just over 2° C.; at Station 162 it was not taken. Although the specimens from the Maldive area extend the known range of this brittle-star some three thousand miles to the north, well across the equator, the environmental conditions (save for pressure) are apparently much the same.

OPHIOPHTHALMUS RELICTUS (Koehler).

Ophiacantha relictus Koehler, 1904, p. 106; pl. 17, figs. 4–6.

Ophiophthalmus relictus Matsumoto, 1917, p. 106.

LOCALITY.—Station 184; Gulf of Aden; 1270 metres. One specimen.

RANGE.—Omai Saki Light, Southern Japan, to the vicinity of Rotti and southwestern Timor, 538–1624 metres.

NOTES.—This is a well-preserved adult, 10 mm. across the disk, with arms about 40 mm. long. The dry specimen is nearly or quite white. The granulation of the disk is sparse and the granules themselves are small and tend to be pointed; this is somewhat less true of the granules on the upper arm-plates.

REMARKS.—The occurrence of this East Indian species in the Gulf of Aden at the

same station with two species of *Ophiotreta*, also first collected by the "Siboga" is remarkable, since none of the species has been taken in the Indian seas by the "Investigator". Comparison of a paratype of *Ophiacantha cecidisca* H. L. Clark (1911, p. 219) with this specimen demonstrates their identity, and further comparison with a co-type of *O. relicta* proves that Koehler (1922) was right in relegating the Japanese species to the synonymy of his East Indian form. Matsumoto (1917) and I (1915) both failed to understand Koehler's (1904) description and figures, but in 1922 the eminent French authority made his position perfectly clear.

OPHIOTOMA ASSIMILIS Koehler.

Ophiotoma assimilis Koehler, 1904, p. 144; pl. 28, figs. 1, 2.

LOCALITY.—Station 62; northern area of Arabian Sea; 1893 metres. Four specimens.

RANGE.—South-eastern Luzon, Philippine Islands, south to Rotti and Timor, 402–1033 metres.

NOTES.—The specimens at hand are in poor condition and rather small, only 10–13 mm. across the disk. The arms are broken in all, and in only one is the disk covering present. The colour is more or less white; the only entire disk is greenish grey.

REMARKS.—I can find no satisfactory reason for doubting that these *Ophiotomas* are the same species as those taken by the "Albatross" and well figured by Koehler (1922). The figures given with the original description are rather misleading. It is interesting to note that we have here another "Siboga" species which was not taken in the Indian seas by the "Investigator", but is found by the "Mabahiss" in Arabian waters.

Koehler (1922, p. 95) has questioned my uniting (1915, p. 217) Lyman's *Ophiacantha bartletti* and *Ophiotoma coriacea*, but a careful re-examination of Lyman's material leads me to think the union is right. The type of *coriacea* is so much larger and more mature than the type of *bartletti* that there is good reason for being uncertain as to the identity, but the reasons given by Koehler are due to his reliance on Lyman's figures, and unfortunately the figure showing the under arm-plate of *coriacea* is inaccurate and hence misleading. The under arm-plates are not essentially unlike those of *bartletti*, and I may add, *assimilis*. The notch in the distal margin of these plates, which Koehler regards as a very particular feature of *assimilis*, is present in all the *Ophiotomas* I have examined, except possibly the Japanese *megatrete*, where it is nearly or quite wanting. With sufficient well-preserved material at hand, it is quite likely that *assimilis* and *bartletti* would prove to be indistinguishable.

OPHIOMYCES DELATA Koehler.

Ophiomyces delata Koehler, 1904, p. 100; pl. 17, fig. 9; pl. 18, figs. 1, 2.

LOCALITY.—Station 109; Zanzibar area; 640 metres. One specimen.

RANGE.—Mindanao, Philippines, to Kei Islands, 210–4239 metres.

NOTES.—This is a very fine specimen in remarkably good condition. The disk is 8 mm. in diameter and 5 mm. high, and carries a number of scattered spinules, of diverse sizes; the largest are more than a millimetre long, very slender and acute, a little thorny near base. The arms are 30 mm. long, rather wide at base, but tapering to a slender tip. The colour of the dry specimen is nearly white.

REMARKS.—Although this specimen does not agree in all details with Koehler's description, it is so nearly like the photographs he published later (1922) that I think it would be foolish to describe it as a distinct species. I must confess myself at a loss to understand Koehler's fig. 13, pl. 96, which is said to represent arm-spines of this species; there is obviously some mistake, either in the text on p. 42, or in the lettering of the plate.

Order GNATHOPHIURIDA.

Family AMPHIURIDÆ.

AMPHIURA ATLANTICA Ljungman.

Amphiura atlantica Ljungman, 1867, p. 321.

Amphiura dilatata Lyman, 1879, p. 26; pl. 11, figs. 314–316.

Amphiura atlantica var. *dilatata* Mortensen, 1933a, pp. 351–353, figs. 59, 60b.

LOCALITY.—Station 113; Zanzibar area; 220 metres. Two specimens.

RANGE.—St. Helena and coast of South Africa, near the Cape of Good Hope.

NOTES.—These specimens are only 3 mm. across the disk (one is diskless) and are in very poor condition, all the arms being twisted and broken, but there is little reason to question the identity.

REMARKS.—The identity of Ljungman's and Lyman's species seems to me demonstrated satisfactorily by Mortensen, and I can see no merit in retaining *dilatata* as a variety, the difference in the slenderness of the outer oral papillæ being too slight and untrustworthy a character. The extension of the range of *atlantica* to the Zanzibar area is interesting, but not extraordinary.

AMPHIURA DIOMEDEÆ Lütken and Mortensen.

Amphiura diomedæ Lütken and Mortensen, 1899, p. 151; pl. 12, figs. 1–7.

LOCALITIES:

Station 54; South Arabian coast; 1046 metres. Twenty specimens.

Station 143; Maldivé area; 797 metres. Five specimens.

RANGE.—From the Gulf of Panama and coast of Ecuador to Japan and South Africa, in depths ranging from 70 metres (Japan) to 2877 metres (Ecuador).

NOTES.—All of the specimens are small, 3–6 mm. across the disk, but they are for the most part in good condition. The species is notorious for its diversity in mouth parts and other details, so it is not surprising that the specimens from the Maldivé area are obviously different from those from the South Arabian coast. The latter have a more delicate appearance with thinner, flatter disk and more delicate mouth parts and arm-plates. The Maldivé specimens are stouter with a more porcelain-like finish, and are almost ivory white in colour. The Arabian material has the disks greyish and the arms yellowish white.

REMARKS.—Koehler's (1922, p. 159) unwillingness to accept Matsumoto's (1917, p. 198) claim that *diomedæ* is a synonym of *koreæ* Duncan is amply justified, for Duncan (1879, p. 480) says his species has mouth parts "remarkably like" *Amphiura squamata*. Hence it is clearly an *Amphipholis*. Moreover he says (p. 466) that the arms are broad,

“not much more than twice the length of the diameter of the body”, while in *diomedea* the arms are 5–7 times the disk-diameter. The extension of the range of *diomedea* to the Arabian coast is quite to be expected. Its absence from the collections of the “Investigator” is remarkable, and one can but wonder whether it is not identical with *caulleryi* Koehler, which the Indian survey ship took at two stations. As I have seen no specimens of *caulleryi*, however, and Koehler never suggested any similarity between the two species, it would be unwise to assert their identity.

AMPHIURA GRANDISQUAMA Lyman.

Amphiura grandisquama Lyman, 1869, p. 334. Mortensen, 1933b, p. 452, figs. 19a–d.

LOCALITY.—Station 176; Gulf of Aden; 655–732 metres. One specimen.

RANGE.—Florida and West Indies and eastward across the Atlantic, and south to St. Helena, 18–1850 metres; Philippine Islands, 77–686 metres; off Natal, South Africa, 405 metres.

NOTES.—This is a large and well-preserved Amphiurid, over 5 mm. across the disk, with arms about 30 mm. long. The dry specimen is nearly white, with the disk somewhat more greyish than the arms. The disk scaling is coarse and the radial shields rather large.

REMARKS.—As both Koehler and Mortensen have compared their material from the Philippines and South Africa with specimens from the Atlantic, and consider the identity well established, I record this specimen as *grandisquama*. But comparison with Lyman's type and other western Atlantic material, shows certain differences, particularly in the disk covering that make me think it probable the Indian Ocean form has distinctive characters, which will justify its separation from *grandisquama* when sufficient well-preserved material is available.

AMPHIURA NOCIVA Koehler.

Amphiura nociva Koehler, 1904, p. 78; pl. 15, figs. 3–5.

LOCALITY.—Station 143; Maldive area; 797 metres. Two specimens.

RANGE.—Known only from “Siboga” Station 251, vicinity of the Kei Islands, 204 metres.

NOTES.—These specimens are a little smaller than Koehler's unique type, but correspond to his description and figures with surprising closeness. They are in fairly good condition, though the disk is somewhat damaged in each. Their colour is nearly white. The larger is 5 mm. across the disk, with arms exceeding 30 mm.; no arm is complete. The other specimen is only a trifle smaller. In both, the upper and under arm-plates have a shining, porcelain-like appearance.

REMARKS.—It is a bit strange that this East Indian species was not found by either the “Albatross” or by Dr. Mortensen in their extensive collecting in that region. Its rediscovery by the “Mabahiss” is of very unusual interest. The species is well characterized by its radial shields, upper and under arm-plates, oral shields, adoral plates and arm-spines. The tentacle-scales are very small and on many pores it is very difficult (or impossible) to make out two.

AMPHIURA UNCINATA Koehler.

Amphiura uncinata Koehler, 1904, p. 76 ; 1922, pl. 65, figs. 6-8.

LOCALITIES :

Station 42 ; South Arabian coast ; 1415 metres. One specimen.

Station 105 ; Zanzibar area ; 238-293 metres. Two specimens.

RANGE.—Mindoro, Philippine Islands to Java and the Kei Islands, 100-518 metres. Also off Durban, Natal, 405 metres.

NOTES.—The specimen from Station 42 is a large one, 10 mm. across the disk, but it is in very poor condition, all the arms being broken at a dozen millimetres from the disk or less. The larger of the two from Zanzibar is 7.5 mm. across the disk, and three arms are more or less complete, the longest about 70 mm. long. They are well over a millimetre wide 15-20 mm. from the disk, and taper very gradually to the broken tips. The smaller specimen is only 4 mm. across the disk ; the arms are slender and broken, the most complete little exceeding 20 mm. As might be expected, the curved (or hooked) spines are not as yet well developed, but otherwise the resemblance to the larger specimens is close. The largest specimen is quite white, the next is more yellowish, while the smallest has the disk very light grey ; the arms white.

REMARKS.—The differences between these specimens and Koehler's original description and figures are very considerable, but his later photographs (1922) satisfy me that the "Mabahiss" material should be referred to *uncinata*. There are two causes for doubt, however, for the external oral papilla is more spiniform than in Koehler's (1904) figure and description (even his photograph (1922) does not reveal a really spike-like form), and the interbrachial areas below are more or less completely covered with minute scales. As regards the oral papilla, the three individuals at hand show some diversity ; in the larger Zanzibar specimen the resemblance to Koehler's photograph (pl. 65, fig. 6) is not so hard to see. The covering of the interbrachial oral areas is probably subject to much diversity, associated with breeding conditions and local factors. Unfortunately Koehler (1930) does not give any information concerning the three specimens from the Kei Islands taken by Dr. Mortensen. However, since Mortensen (1933a) has referred specimens from Natal to *uncinata*, it seems proper to regard this "Mabahiss" material as representative of the same species.

AMPHIURA CERAMIS* sp. nov. (Text-figs. 14 and 15.)

LOCALITIES :

Station 33 ; Gulf of Aden ; 1295 metres. Six specimens.

Station 105 ; Zanzibar area ; 238-293 metres. Four specimens.

Station 184 ; Gulf of Aden ; 1269 metres. One specimen.

Station 185 ; Gulf of Aden ; 2000 metres. Three specimens.

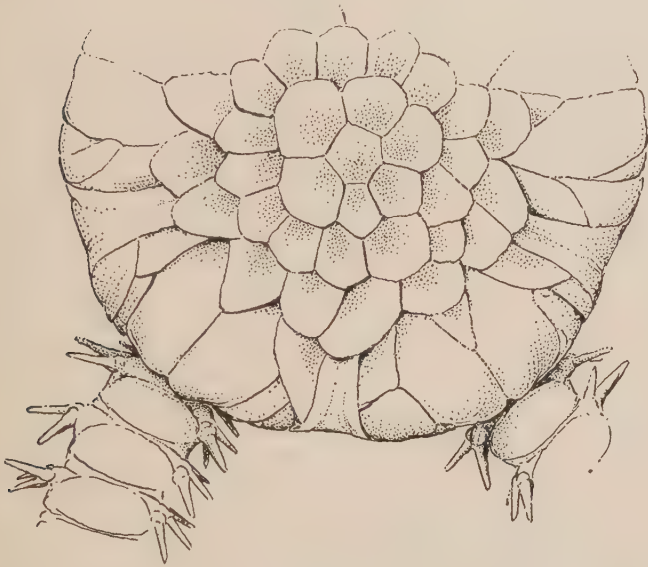
DESCRIPTION.—Disk 7 mm. in diameter, flat and nearly circular ; arms 5, about 35 mm. long, a millimetre wide at base, tapering gradually to the attenuate tip. Disk covered with about 75-80 coarse, flat, overlapping scales and the five pairs of radial shields ; the plates at the centre of the disk are largest and measure fully a millimetre across, yet the 6 primary plates are not well defined ; a large triangular plate separates the inner ends of the radial shields ; interrachial areas with three ill-defined series of plates which

* κεραμῖς = tile, in reference to the coarse tile-like disk-scales.

tend to be longer than wide. Radial shields large, much longer than wide, the distal portions broadly in contact; the inner ends conspicuously separated and the outer margins markedly convex. Upper arm-plates rounded quadrilateral or pentagonal, slightly arched, more or less broadly in contact, but all margins ill-defined, much wider than long basally, but becoming longer than wide distally.

Interbrachial areas below fully covered with coarse, flat scales like those of the disk, but smaller. Under arm-plates longer than wide, the first very small, scarcely one-fourth the second, with all angles rounded; second and following plates with a nearly straight proximal, a slightly convex distal, and concave lateral margins; they are distinctly but narrowly separated from each other by the meeting of the side arm-plates in the mid-ventral line. The latter do not seem to meet on the upper side of the arm, though they probably do so distally. Each plate carries a series of 3 short arm-spines, thickened at

TEXT-FIG. 14.



TEXT-FIG. 15.



TEXT-FIGS. 14, 15.—*Amphiura ceramis* sp. nov. FIG. 14.—Dorsal view of disk. $\times 10$. FIG. 15.—Oral view of mouth parts and base of one arm. $\times 10$.

base, pointed at tip, the middle one longest, but even at base of arms scarcely as long as an arm-segment. Tentacle-scales 2 at base of arm, small, flat and rounded; distally the one on the under arm-plate vanishes.

Oral shields small, pentagonal, longer than wide, with a rather sharp proximal angle, the proximal lateral angles also evident, but the distal angles rounded; distal half of plate much narrower than proximal and markedly depressed, so that at first sight the shield appears to be triangular and wider than long; madreporite much larger than the others, slightly swollen, and of an irregular rounded form. Adoral plates relatively very large, much longer than wide, meeting broadly within, widest distally where they extend up between the oral shield and side arm-plate. Oral plates not distinct. Oral papillæ conspicuous; inner pair notably large and block-like, longer than wide; at distal end of mouth-slit on each side are two rounded scale-like papillæ, much like and little larger than the first tentacle-scales of the arm; one seems to be attached to the adoral plate, the other to the first under arm-plate; tentacle-scale of inner oral pore large and noticeable on

three jaws, but apparently wanting on one or two. Teeth conspicuously large and wide, with smooth, rounded margin. Colour of disk, in dry specimen, very pale grey; arms nearly white, with a porcelain lustre.

REMARKS.—The holotype, the largest specimen, is from Station 185 in the Gulf of Aden. The other specimen from that station is scarcely 5 mm. across the disk, which has the appearance of being covered by a very delicate membrane, obscuring the outlines of the plates. This is, however, possibly an artefact, as it also conceals the outlines of the oral shields and mouth parts. All the oral papillæ are abnormally small and poorly developed. The specimens from Stations 33 and 184 are also from deep water in the Gulf of Aden. All are relatively small, 2.5–5 mm. across the disk, and agree in nearly all particulars with the type, but in one respect are most perplexingly different. The oral papillæ, aside from the block-like apical pair, shows remarkable diversity in number, form and position. The two rounded scale-like papillæ at the angle of the oral slit are always present, but in every specimen and on nearly all jaws are accompanied by additional papillæ. In most cases the additional papilla which is near the middle of jaw-margin, is similar to the others in form, but is much smaller; sometimes it is narrow and more spiniform. In several specimens still another spiniform papilla is present proximal to the others. In such specimens there are, then, on a single jaw-margin a block-like apical papilla, a conspicuous sharp oral tentacle-scale (at a higher level, of course), a narrow, somewhat spiniform papilla, a small papilla either spiniform or scale-like, and 2 flat, scale-like papillæ. Curiously enough the proximal papillæ are well-spaced and the appearance of the jaw is not as in *Amphioplus*. The specimens from Zanzibar are all small (3–4 mm. across the disk), but show no diversity in the number or form of the oral papillæ. It is probable therefore that 2 papillæ at the mouth angle is the normal condition, and the individuals with more than that number are “progressive variants”. The resemblance of the oral surface of *ceramus* to that of *diomedea* is obvious, and it seems best to regard it as a member of that irregular section of the genus *Amphiura* of which *diomedea* is the outstanding representative. When sufficient well-preserved material of the species composing this group, of which several are now known, is available, it is probable that they will be segregated as a distinct genus. Unless this is done it will be increasingly difficult to give a satisfactory diagnosis for *Amphiura*.

AMPHIURA CRYPTA* sp. nov. (Text-figs. 16–17.)

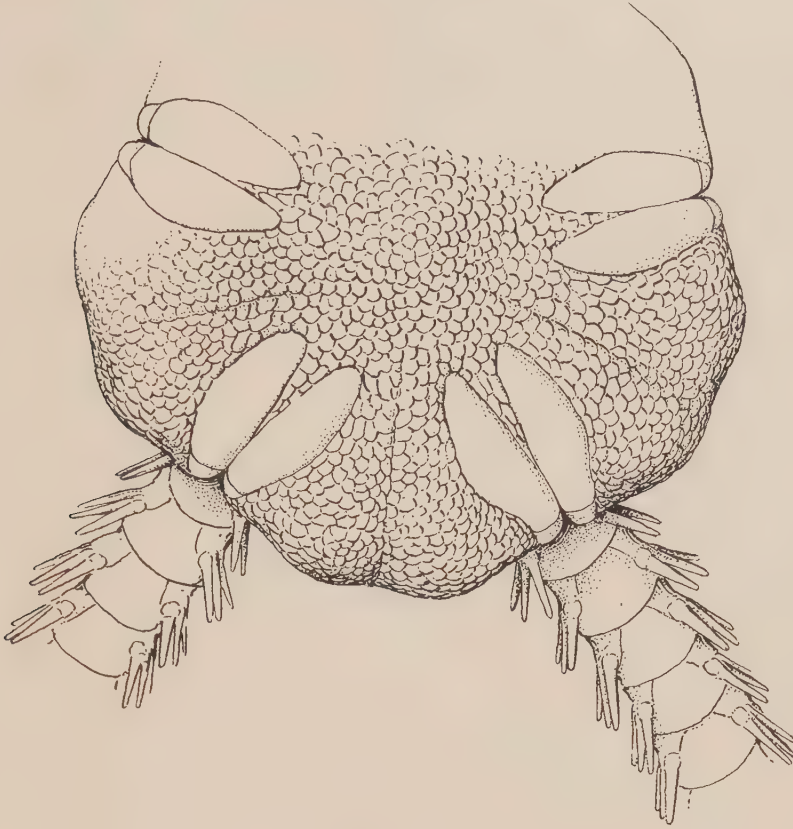
LOCALITY.—Station 24; Gulf of Aden; 73–200 metres. Three specimens.

DESCRIPTION.—Disk 3 mm. in diameter, flat, rounded pentagonal; arms 5, short and relatively stout, all are broken but the longest could hardly have exceeded 12 mm. Disk covered with numerous irregular, overlapping scales of diverse sizes; largest between proximal ends of radial shields, but some on the interradial line near centre of disk are nearly as large; none of the scales are well-defined, as a very delicate membrane seems to cover the whole disk. Radial shields a millimetre in length, about 2.5 times as long as wide, the inner margin nearly straight or a trifle concave, the outer distinctly convex; they are more or less separated from each other except at the distal end. Upper arm-plates rather large, wider than long, with all angles rounded; distal margin convex;

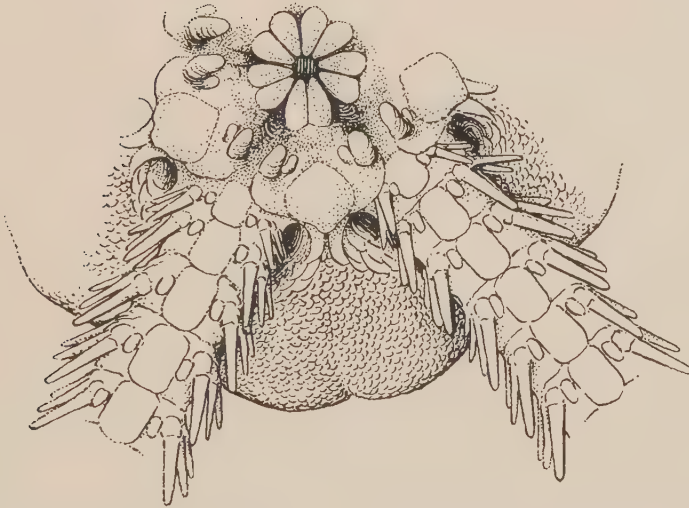
* *κρυπτός* = concealed, in reference to the obscured oral plates.

proximal margin obscurely narrowed and truncate, but its outline is indistinct ; they are seemingly more or less in contact.

TEXT-FIG. 16.



TEXT-FIG. 17.



TEXT-FIGS. 16, 17.—*Amphiura crypta* sp. nov. FIG. 16.—Dorsal view of half of disk and two arm-bases. $\times 25$. FIG. 17.—Oral view of same. $\times 25$.

Interbrachial areas below completely covered with overlapping scales like those of the disk. First under arm-plate small and obscure ; succeeding plates apparently longer than wide, with distal margin convex but notched at middle, the proximal narrowed and

truncate; apparently they are in contact, but the outlines are not very clear. Side arm-plates moderate, not at all conspicuous; each carries 4 (or basally 5) terete, smooth, opaque, bluntly pointed spines, the uppermost, equalling the segment, is shortest; the lowest is abruptly largest and equals a segment and a half or perhaps more. Tentacle-scale single, of moderate size, flat and rounded, too long to be circular.

Oral shields and the whole oral frame with outlines more or less completely obscured by overlying membrane; this is most marked in the holotype, and least opaque in the smallest paratype; oral shields are about as wide as long, the madreporite distinctly largest and nearly elliptical. Adoral and oral plates quite obscured. Oral papillæ as usual in the genus, a pair of thick block-like ones at the tip of jaw and an isolated, narrower one at mouth-angle; this distal papilla is erect, thick, bluntly pointed, two or more times as long as wide. Teeth not noticeable. Colour (dry) pale yellowish white, the disk with a hint of grey.

REMARKS.—This little brittle-star cannot possibly be referred to any *Amphiurid* in this collection, nor can I find any described species to which it may be assigned. The two paratypes are distinctly smaller than the one described, but agree with it in the essentials—the scaling of disk, the radial shields, the upper and under arm-plates, the obscured oral frame, the oral papillæ, the single tentacle-scale and the enlarged lower arm-spine. In one respect, however, they have a very different appearance. In the holotype the arm-spines are appressed more or less closely to the side of the arms; in the paratypes they are very irregularly bristling. The number of spines is also fewer and the lowest is not so distinctly larger than the others.

*AMPHIURA DEJECTOIDES** sp. nov. (Text-figs. 18 and 19.)

LOCALITY.—Station "B", presumably MBb; Red Sea; 29 metres. Four specimens.

DESCRIPTION.—Disk 6 mm. in diameter in the dry specimen, but obviously shrunken; in life it was soft, puffed up, with large interbrachial lobes; arms 5, much contorted, but not less than 60 mm. long and probably more, tapering slowly to the attenuate tip. Disk covered with very numerous, minute scales; a few of those close to the proximal ends of the radial shields are markedly larger. Radial shields very long, narrow and somewhat curved, separated from each other, except at distal end, where they may possibly be in contact, but probably not in life; length 3–4 times the width. Upper arm-plates elliptical, much wider than long, more or less in contact.

Interbrachial areas below covered with minute scales, but it is possible that near the oral shields the skin is naked, though it is not thin there. First under arm-plate very small and apparently separated from the second by the adoral plates; second plate much larger, nearly square, with rounded corners; succeeding plates similar, but a little larger and becoming longer than wide; all are in contact with each other or separated by a narrow groove; distal end becomes wider than proximal. Side arm-plates not large or conspicuous, and apparently not meeting either above or below; each plate carries a series of 5 stout spines, the lowest is pointed and is longest, except on the basal arm-segments, and distally exceeds them; the uppermost is shortest, blunt and somewhat flattened; the other three are intermediate in size and form, but one or two may have the tip thickened or widened. As the spines stand out at right angles from the arms, the latter are quite

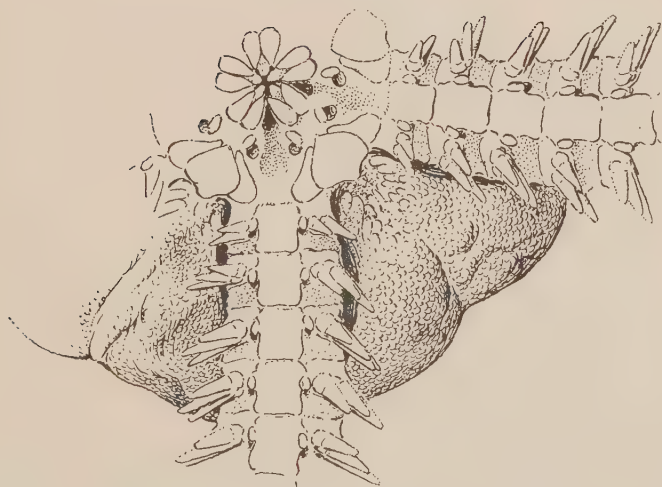
* *dejectoides* = like *dejecta*, an East Indian species which it resembles in many features.

bristling. Tentacle-scale single, flat and rounded, rather large at base of arm, but distally it is small.

TEXT-FIG. 18.



TEXT-FIG. 19.



TEXT-FIGS. 18, 19.—*Amphiura dejectoides* sp. nov. FIG. 18.—Dorsal view of half of disk and an arm-base. $\times 20$. FIG. 19.—Oral view of same. $\times 20$.

Oral shields, and the whole oral frame, with outlines rendered more or less indistinct by overlying skin. Oral shields small, pentagonal, wider than long, with all angles rounded. Adoral plates short and wide, not meeting within, but sometimes meeting radially between

the first and second under arm-plates; this meeting is not very complete and probably is not so marked in living or well-preserved material. Oral plates small. Inner oral papillæ thick, more or less pointed, not very large; outer ones slender, blunt and erect. Teeth not very wide or conspicuous with a rounded or nearly straight margin. Colour of disk in dry specimen pale grey; arms yellowish white, but there is no marked contrast.

REMARKS.—Of these four specimens, three are much alike in size, colour and general appearance, but the fourth is much younger, only 4 mm. across the disk, which is somewhat darker coloured than in the large specimens. All are in poor condition with the long arms badly contorted.

The presence of a single tentacle-scale, the five arm-spines, and the form of the oral shields led at first to the conclusion that these brittle-stars were examples of Koehler's (1922, p. 154) species *dejecta*, known only from a single specimen from Borneo. But the differences in disk and disk-covering and in the outer oral papilla preclude such a decision, which is further negated by the much greater depth at which *dejecta* was taken. The Red Sea species is obviously one of the long-armed, mud-loving, shallow-water Amphiurans, and seems to be quite distinct from any previously known.

AMPHIURA EUGENIOIDES* sp. nov. (Text-figs. 20 and 21.)

LOCALITY.—Station 54; South Arabian coast; 1046 metres. One specimen.

DESCRIPTION.—Disk 2 mm. in diameter, flat, nearly circular; arms 5, about 16 mm. long. Disk covered with numerous overlapping scales among which the 6 primary plates are easily distinguished. Radial shields small, about twice as long as wide, well separated within, but more or less nearly in contact distally. Upper arm-plates a little longer than wide, with distal margin convex and proximal end truncate, more or less clearly in contact.

Interbrachial areas below fully covered with small scales. Under arm-plates oblong with rounded corners, longer than wide, the distal margin a little concave, the proximal a trifle convex, broadly in contact. Side arm-plates not notable, each with 5 or 4 short, pointed, nearly equal arm-spines about as long as a segment; they stand out at right angles to the otherwise narrow arm. Under high magnification ($\times 90$) one or two in each series, near base of arm, show a distinct hyaline tooth projecting laterally from the tip, but this is so inconspicuous it might be easily overlooked. Tentacle-scales 2, of rather small size; distally the one on the under arm-plate seems to be wanting.

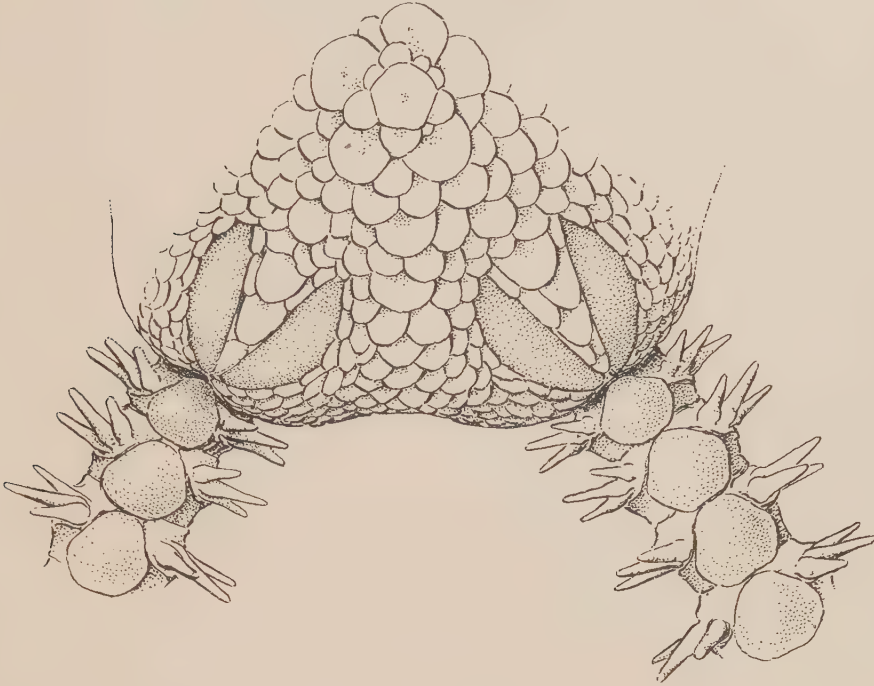
Oral shields oval or rounded pentagonal, narrowest distally, bluntly pointed within. Adoral plates, short and wide, apparently not quite meeting within. Oral papillæ 2 or 3 on a side; the usual thick, block-like proximal pair, a relatively large flat, oval distal scale, and usually a similar but much smaller scale, distal to it. This arrangement is much as in *diomedea*, but the scales themselves have a very different shape. Colour (dry) of disk very pale grey, the arms more nearly white.

REMARKS.—This little Amphiura is so exactly like *A. eugenia* Ljungman that a detailed description would be quite superfluous if that species had ever been adequately described. Were the "Mabahiss" specimen from the South Atlantic near South America it would be referred to *eugenia* without hesitation. I have compared it carefully with specimens of *eugenia* from off La Plata and with a fine specimen from the Falkland Islands,

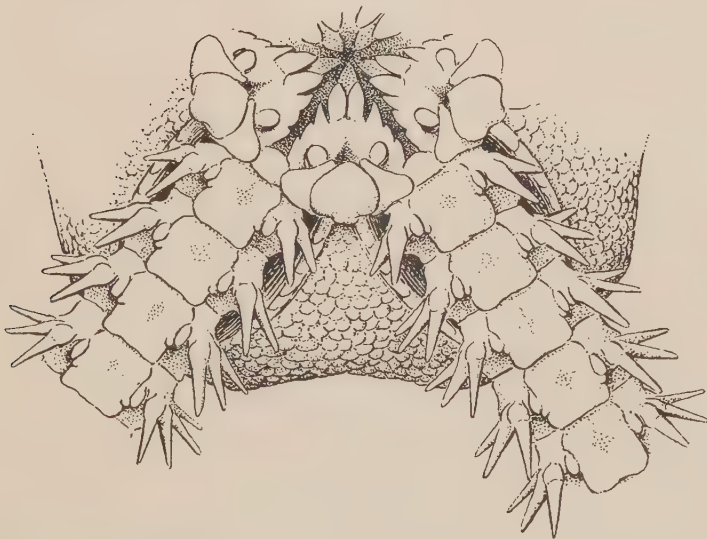
* *eugenioides* = like *eugenia*, a South Atlantic species which it much resembles.

and I can find no important differences. Besides the tooth at the tip of some arm-spines, which I have not found in *eugeniæ*, the only difference is in the surface of the interbrachial areas ; in the South Atlantic species, the scales are a trifle swollen, so the surface seems very

TEXT-FIG. 20.



TEXT-FIG. 21.



TEXT-FIGS. 20, 21.—*Amphiura eugenoides* sp. nov. FIG. 20.—Dorsal view of part of disk and two arm-bases. $\times 30$. FIG. 21.—Oral view of nearly half of lower surface. $\times 30$.

finely granular, while in the Arabian specimen the surface is smooth. This difference may well be a youthful character, as the "Mabahiss" specimen is much smaller than any of the *eugeniæ* at hand. Owing to the extraordinary geographical difference in occurrence it seems unwise to list the Arabian specimen as *eugeniæ*. By calling it *eugenoides* its

resemblance to the South American form will be emphasized, and the above description will be of assistance in identifying Ljungman's species.

AMPHIUURA MEGALASPIS* sp. nov. (Text-figs. 22 and 23.)

LOCALITY.—Station 54; South Arabian coast; 1046 metres. One hundred and forty-two specimens.

DESCRIPTION.—Disk 6 mm. in diameter, flat, rounded pentagonal; arms 5, all broken, but, judging from other specimens, about 30 mm. long, tapering to an attenuate tip. Disk covered chiefly by the 5 pairs of relatively huge, thin, radial shields; each shield is about 2.5 mm. long by 1.5 mm. wide at distal margin, its proximal end bluntly pointed, or more or less rounded; each pair of shields forms a radial wedge, suggestive of *Ophioplinthaca*, though there are no interradian furrows; the centre of disk and the narrow interradian areas are covered by crowded, thin, overlapping scales of moderate size. Upper arm-plates broadly oval, as wide as long or wider; the narrower proximal end is more or less truncate where in contact with the strongly convex margin of the preceding plate.

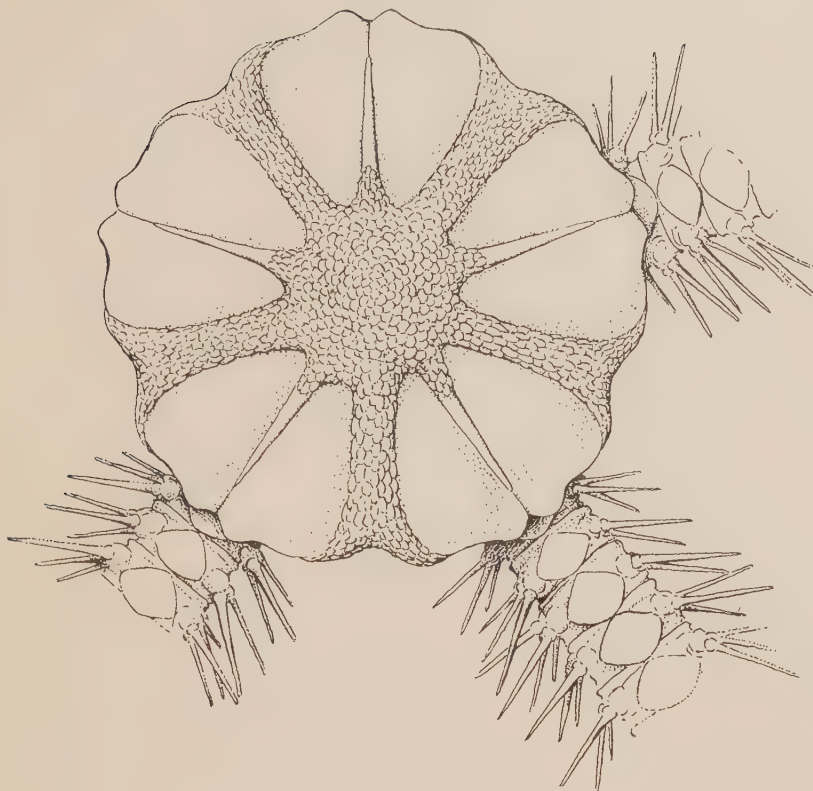
Interbrachial areas below fully covered with thin plates. First under arm-plate pentagonal, rather broadly in contact with the second, which, like the succeeding plates, is markedly longer than wide; all are thin and more or less in contact; each plate is narrower proximally than distally and is raised into a low but rather evident keel along the mid-line; all angles are rounded. Side arm-plates small; each carries 4 (at base of arm, 5) slender, acute, fragile arm-spines, of which the lowest is longest and equals or exceeds two arm-segments. Tentacle-scale single, rather large, flat, thin and elliptical or nearly circular.

Oral shields rather large, especially the madreporite, much wider than long, the inner margin convex, the outer projecting as a rounded lobe. Adoral plates small, about 3 times as long as wide, lying on the inner margin of the oral shield, but not meeting in the mid-line. Oral papillæ conspicuous but rather delicate; inner pair, somewhat block-like, but the tip is obliquely pointed, or notched, with a large point on one side and a small one on the other; distal papilla slender, erect, acute, three times as high as base width. Tentacle-scale of inner oral pore conspicuous, triangular, sharply pointed. Teeth narrow, with convex margin. Colour of disk (dry) pale grey; arms more nearly white.

REMARKS.—This species is undoubtedly nearly related to *grandisquama*, but is easily distinguished by the huge radial shields. These, with the long arm-spines, give the appearance of an Ophiacanthid, especially *Ophioplinthaca*, but the oral surface promptly dispels such an illusion, as the resemblance there to *grandisquama* is obvious. The whole structure is, however, much more delicate and fragile than in that species, and suggests at once a deep-water habitat. Most of the material is in poor condition and shows little diversity in either size or appearance. It is divided into six lots (Op. 48, 70, 89, 126, 168, 174), of which No. 70 is a single specimen, the holotype. With 48 (2 specimens) is a field note (46) which says: "A sample of very soft rock evidently bored by some animal which has now been exterminated. The holes were occupied by a sparse secondary fauna, consisting mostly of Polychæts, with an occasional mollusc or ophiuroid. The rest of the catch consisted of mud-dwelling forms." With 168 (2 specimens) is a field note (151) saying: "Worms, worm-tubes, 2 ophiuroids, 1 barnacle and 1 hydroid from 'Apple-sponge'."

* μέγας = big + ἀσπίς = shield, in reference to the huge radial shields.

TEXT-FIG. 22.



TEXT-FIG. 23.



TEXT-FIGS. 22, 23.—*Amphiura megalaspis* sp. nov. FIG. 22.—Dorsal view of disk and three arm-bases. $\times 12$. FIG. 23.—Oral frame, two arm-bases and an interbrachial area. $\times 12$.

AMPHIONCUS* gen. nov.

Amphiurids with flat disk and arms, large radial shields, naked interbrachial areas below, conspicuously swollen oral plates, and the inner of two distal oral papillæ and the outer of the two tentacle-scales prolonged into a conspicuously-barbed spine.

* *Amphi*, the generic prefix common in this family + $\delta\gamma\kappa\upsilon\varsigma$ = a barb, in reference to the strongly-barbed tentacle-scales.

Genotype : *Amphioncus platydiscus* sp. nov.

The remarkable barbed tentacle-scales (the inner oral papilla being, of course, homologous), the swollen oral plates, and the naked oral interbrachial areas, of the notably flat disk give this genus a very characteristic facies. It is probably to be considered a specialized *Amphiura*, related to the *diomedea* group, rather than to *Amphiodia*, as the distal oral papillæ might suggest. In some particulars it reminds one of *Amphilepis*, but it is not very near that genus.

*AMPHIONCUS PLATYDISCUS** sp. nov. (Text-figs. 24, 25 and 26.)

LOCALITY.—Station 16 ; Gulf of Aden ; 186 metres. Five specimens.

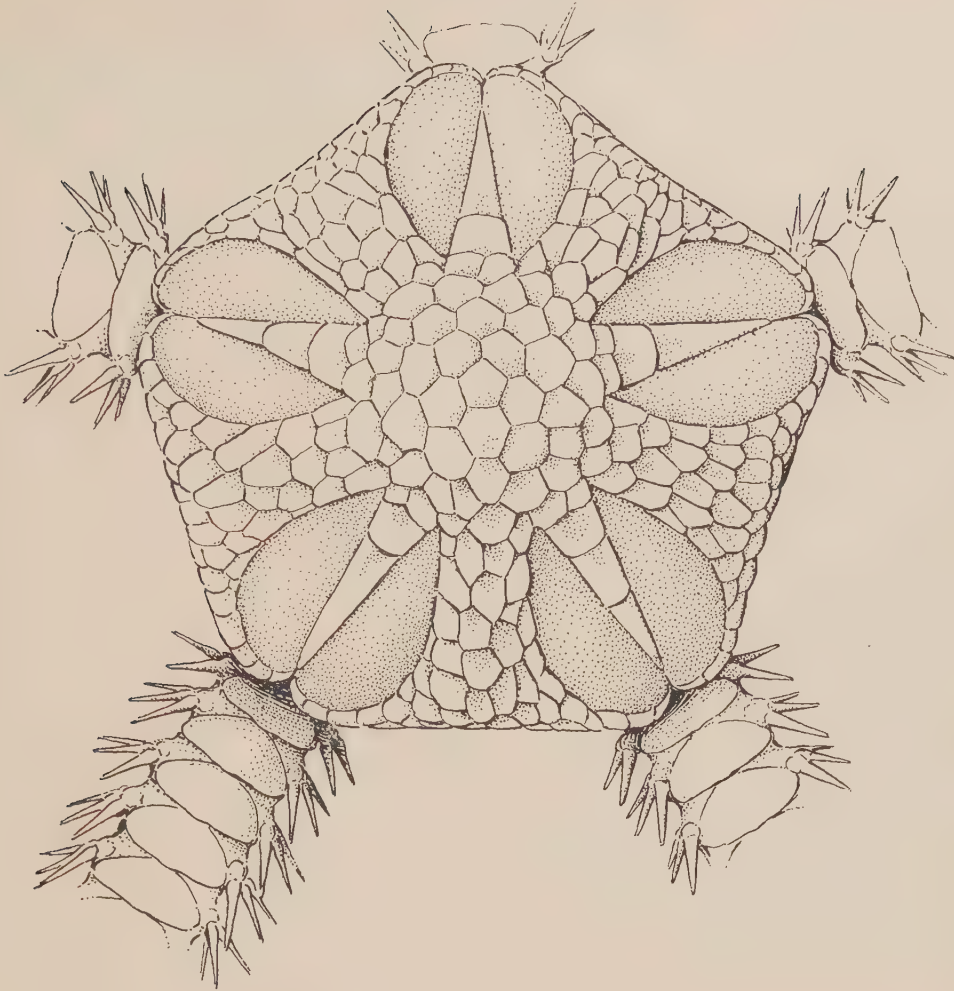
DESCRIPTION.—Disk 7 mm. in diameter, very flat and thin, pentagonal with concave sides and rounded radial angles. Arms 5, rather wide and flat basally, but tapering to a more or less attenuate point, probably (to judge from the paratypes) about 40 mm. long. Disk covered with large, thin overlapping scales, among which the primary plates can, with more or less difficulty, be distinguished. Radial shields large, 2 mm. long by 1 mm. wide ; outer margins convex, inner straight ; the shields are in contact at the distal tips, but diverge considerably so that they are separated by a series of two or three plates, the outermost long, narrow and pointed, and sometimes divided transversely into two, the inner wider than long, with somewhat rounded distal corners. Upper arm-plates large, thin, covering pretty completely the upper surface of arm ; each plate is very much wider than long, with a nearly straight distal margin and a broadly convex proximal side ; some of the plates have short lateral margins, but all angles are rounded ; the plates are more or less in contact, especially at base of arm, but there is much diversity in this detail associated with the flexure of the arm.

Interbrachial areas below covered with a thin naked skin. Under arm-plates much wider than long ; at base of arm they are definitely hexagonal, with a short proximal side in clear contact with the preceding plate ; this is particularly marked between the second plate and the much smaller first, which is scarcely half its size ; distally the side arm-plates crowd in more and more, but it is only far out on the arm that they actually separate the now pentagonal under arm-plates entirely. Side arm-plates small, each with 3 slender, acuminate spines, the middle one usually longest and exceeding the segment ; it is sometimes noticeably widened or thickened at the base. Tentacle-scales 2, of striking appearance ; the inner, lying along the margin of the under arm-plate, is flat and scale-like, longer than wide ; the outer is wide and flat basally where attached to the side arm-plate, but it narrows rather abruptly into a conspicuously barbed spine. This remarkable tentacle-scale is about one-third as long as the arm-segment.

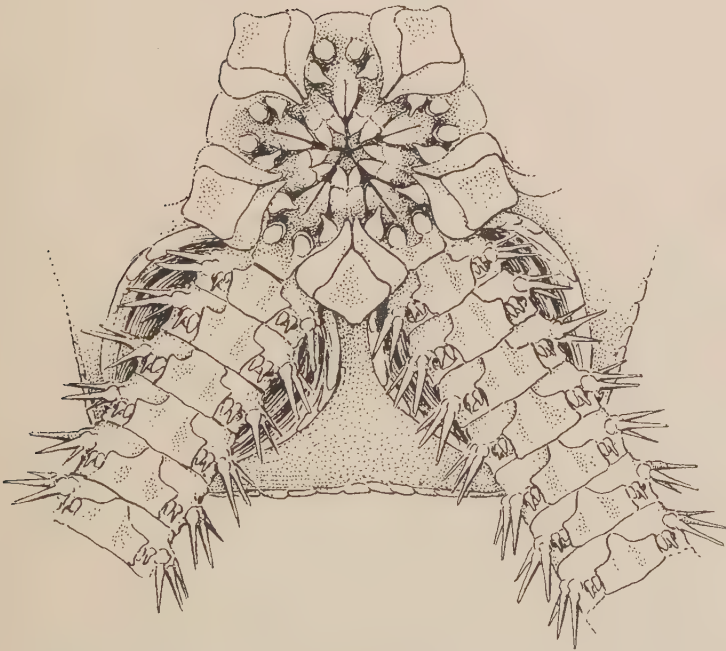
Oral shields rather large, diamond-shape, about as wide as long ; angles slightly rounded and distal one sometimes truncated. Adoral plates large, rounded distally and wider without than within where they meet. Oral plates large, swollen proximally and apparently fused into a single mass on which are borne the pair of block-like, but somewhat pointed, apical oral papillæ. Oral tentacle-scale conspicuously large, thick and pointed. Distal oral papillæ 2 on each side, the outer flat and rounded, the inner like the outer tentacle-scale, but the barbs on the narrowed point are not so long and conspicuous. Teeth thick, rather abruptly narrowed into a rounded point. Colour of disk (dry) pale

* *πλατύς* = flat + *δίσκος* = disc, in reference to the very flattened body.

TEXT-FIG. 24.



TEXT-FIG. 25.



TEXT-FIG. 26.



TEXT-FIGS. 24-26.—*Amphioncus platydiscus* sp. nov. FIG. 24.—Dorsal view of disk and two arm-bases. $\times 14$. FIG. 25.—Oral frame, two arm-bases and an interbrachial area. $\times 14$. FIG. 26.—Tentacle-pore at base of lowest arm-spine, showing the pair of tentacle-scales. $\times 75$.

grey; the margins of the scales are usually lighter than the centre, but this contrast is seldom marked; the arms are more nearly white; the interbrachial areas below are dark grey or brown, or even blackish, in marked contrast to the white genital scales on each side.

REMARKS.—The four paratypes are very similar to the one described, and all are of nearly the same size. They show little diversity in any details, even the scaling of the disk being quite similar in all.

ANAMPHIURA* gen. nov.

Amphiurids with coarse disk-scales, some of which, especially on the interradial margins, carry spinelets; primary plates conspicuous; jaws with apical oral papillæ as in *Amphiura*, but irregular in number (2 or 3), size and position; 2 or 3 distal oral papillæ, flat and rounded, surround the second oral tentacle; papilla of first oral tentacle unusually large and conspicuous, sharply pointed; tentacle-scales 2 or 3 on basal arm-segments, but single and large, as in *Ophiactis*, on most of arm.

Genotype: *Anamphiura valida* sp. nov.

This striking novelty at first suggests *Ophiactis*, by its form, arm-spines and tentacle-scales, but the presence of apical oral papillæ prevents close association with that genus. It seems probable that the nearest relatives are those *Amphiuras* like *diomedea*, which have more than a single distal oral papilla, but the general facies of this ophiuran is so different from those *Amphiurids*, it cannot be associated with them at all closely. It is evidently an aberrant and apparently still unstable form, whose oral characters are not yet firmly fixed.

ANAMPHIURA VALIDA† sp. nov. (Text-figs. 26A and 27.)

LOCALITY.—Station 105; Zanzibar area; 238–293 metres. Four specimens.

DESCRIPTION.—Disk 5 mm. in diameter, somewhat circular, but deep radial notches for the insertion of the arms make it appear 5-lobed; it is distinctly elevated, the vertical diameter being more than a millimetre. Arms 5, only 11 mm. long; about a millimetre wide at base, but tapering steadily to a flattened attenuate tip. Disk covered by a coat of coarse scales, most of which are slightly convex; primary plates very conspicuous; the group is nearly 2.5 mm. across and the central plate is .80 mm.; in one interradius there is a large plate separating two of the radials, while it is itself separated from the central plate by 2 small plates; this condition is abnormal, as the paratypes show the primary plates in a symmetrical group of 6. Radial shields small, elliptical, about .80 mm. long by .40 mm. wide; they lie in closely appressed pairs, but slightly separated proximally by a small triangular scale and distally by the first upper arm-plate. Scattered very irregularly over the disk are about 30 slender, acute spinelets, most numerous near the margin of the interradial lobes; these spines are nearly always borne on very small plates. First upper arm-plate small and triangular, separating distal ends of radial shields; second plate (on which the first seems to rest) is also within the disk, oblong, in broad contact with third, which is also wider than long; succeeding plates nearly circular,

* *av*, primitive + *Amphiura*, in reference to its relationship to, but obvious distinction from, that genus.

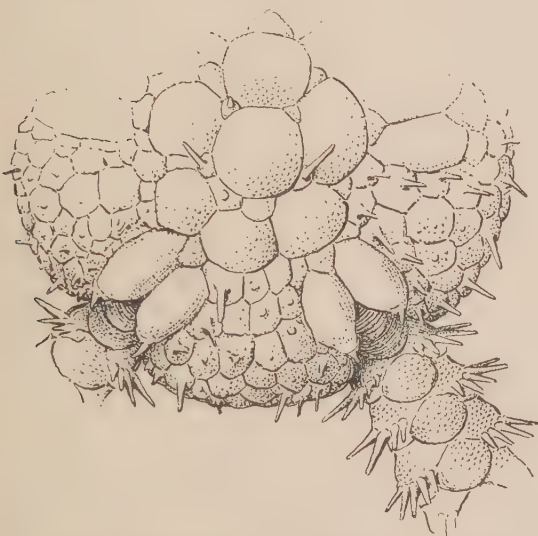
† *validus* = strong, well established, of obvious appropriateness.

conspicuously swollen, about as wide as long, but with the proximal margin slightly extended to touch the preceding plate; distally they become flat and well separated, and are then broadly diamond-shape, with the lateral and distal angles rounded.

Interbrachial areas below, large, well-covered with scales, many of which bear slender, acute spinelets. Genital slits well-marked. First under arm-plate relatively large, oblong, longer than wide, broadly in contact with the second plate; succeeding plates much longer than their median width, but so wide distally that the somewhat convex distal margin equals the length; the narrow proximal end is fully in contact with preceding plate; lateral margins concave, due to the very large tentacle-pores; median area of plate, especially distally, somewhat swollen. Side arm-plates large, stout and projecting, meeting more or less fully above except at base of arm; each plate carries 5 (rarely 6) slender acuminate spines, of which the lowest is biggest and longest, equalling or exceeding

TEXT-FIG. 26A.

TEXT-FIG. 27.



TEXT-FIGS. 26A, 27.—*Anamphiura valida* sp. nov. FIG. 26A.—Dorsal view of half the disk and one arm-base. $\times 14$. FIG. 27.—Oral view of half of lower surface. $\times 14$.

the arm-segment; uppermost is smallest, equalling about one-half the segment. Tentacle-pores very large; on the first three on each side there are 3 or 2 flat, rounded scales, 1 or 2 on the side arm-plate, and 1 on the under arm-plate, but beyond the third segment (*i.e.* outside the disk), there is only one large, nearly circular scale, borne on the side arm-plate; the scale on the under arm-plate has disappeared.

Oral shields diamond-shape, wider than long, made pentagonal by the truncation of the distal angle; the two distal sides are made strongly concave by the end of the genital slit. Adoral plates large, meeting fully within, where they are a little narrower than at the outer end, which rests against the first under arm-plate. Oral papillae conspicuous in two groups; at apex of jaw are 2 (on two jaws, 3) pointed, block-like papillae, not in close contact with each other; in the paratypes there are always 2, except on one jaw, which has but 1; on adoral plate, at outer end of mouth-slit, are 3 flat, scale-like papillae, the middle one largest and most pointed; this group corresponds almost exactly to the tentacle-scales of the first arm-pore. Tentacle-scale of first oral pore very conspicuous, long and pointed. Teeth rather narrow, especially the lowest, with rounded, barely

notched margin. Colour (dry) of disk, glistening ivory white; arms with a very faint tint of brownish.

REMARKS.—This well-marked ophiuran is easily distinguished even in so perplexing a family, by the general facies, the spinulose disk, the arm-plates and the still somewhat generalized mouth parts. The paratypes are 3.5–4.5 mm. across the disk, and agree closely with the holotype in nearly every way.

AMPHIOMYA* gen. nov.

Similar to *Amphipholis*, but having the tentacle-scales so arranged that they suggest by form and position the two valves of a small clam.

Genotype: *Amphiomya notabilis* sp. nov.

The peculiar arrangement of the tentacle-scales quite warrants a new genus for this Amphiuroid, even though there is but one specimen at hand, and that a small one. Fortunately it is in excellent condition.

AMPHIOMYA NOTABILIS† sp. nov. (Text-figs. 28 and 29.)

LOCALITY.—Station unknown. The only label with the specimen is "Op. 11". In the list of Ophiuran lots, Op. 11 is marked "no label". As Op. 10 was taken February 15th, 1934, and Op. 12 October 29th, 1933, it is evident nothing is indicated by the "11", as to either time or place.

DESCRIPTION.—Disk 3.5 mm. in diameter, nearly circular, a trifle convex. Arms 5, slender, 20–25 mm. long. Disk covered by a close coat of rather coarse (relatively), overlapping scales. Radial shields small, about .75 mm. long and .30 mm. wide; they are closely appressed in pairs, only the proximal tips being slightly separated by one or two minute scales. Upper arm-plates relatively large, somewhat convex, rounded triangular or somewhat pentagonal, all angles rounded or proximal one, truncate; distal margin longest, full width of arm, somewhat convex; all plates are slightly in contact where truncated proximal angle meets the margin of preceding plate.

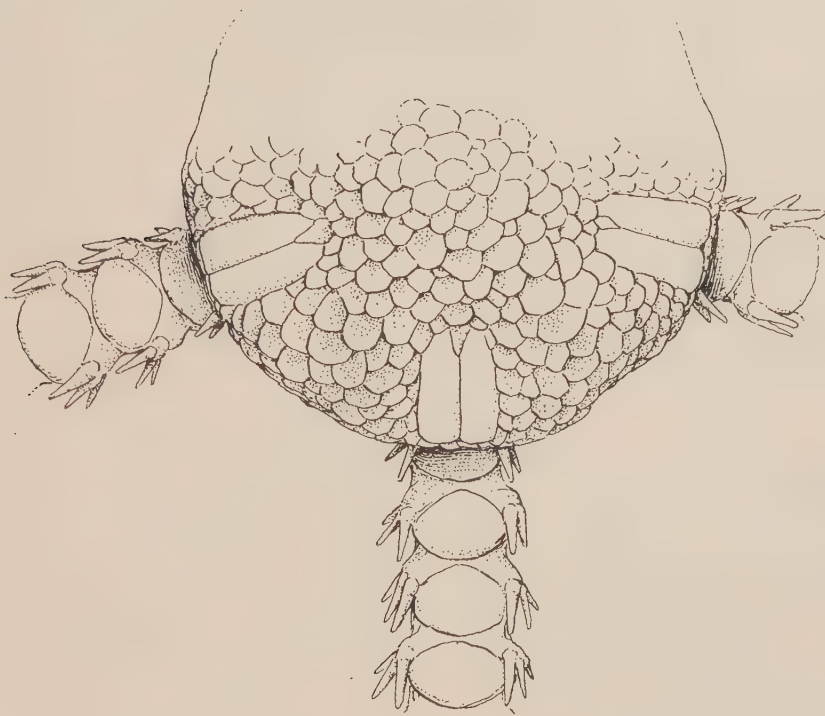
Interbrachial areas below wide, densely covered with small but thick plates. First under arm-plate pentagonal, longer than wide, small but completely separating the adorals, and distinctly in contact with the second plate, which is also pentagonal, but about four times as large, and as wide as long; succeeding plates similar, but wider than long, with straight distal margin and sides, and a rather blunt proximal angle. Side arm-plates large but mainly oral, completely and widely separating the under arm-plates, but not quite in contact above. Each bears 3 short, subequal, thick, bluntly pointed arm-spines not much more than half as long as a segment; they are often appressed to the arm, but may stand out at right angles. Tentacle-scales 2, relatively large, more or less circular and concave, like minute clam-shells; the smaller is attached to the side arm-plate close to the proximal end of the lateral margin of the under arm-plate; the larger is also apparently borne on the side arm-plate with its inner edge adjoining and possibly attached to the under arm-plate; if the tentacle is not extended, the two scales may be shut together

* *Amphi*, the generic prefix common in this family + $\mu\upsilon\varsigma$ = mussel, a bivalve mollusc in reference to the curious clam-like arrangement of the tentacle-scales.

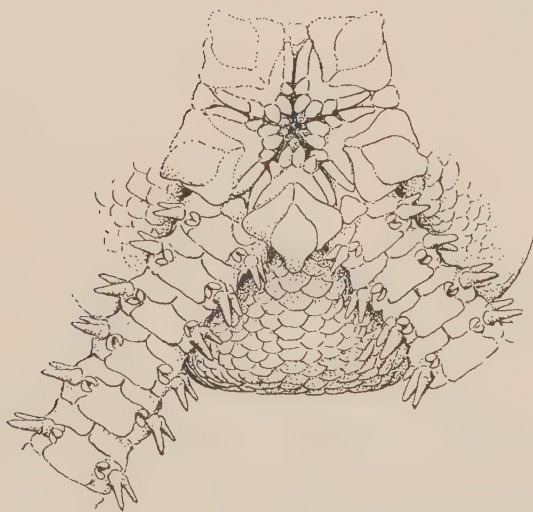
† *notabilis* = worthy of note, in obvious reference to its unusual features.

like a clam-shell. The lowest arm-spine, which is very short within the disk, is just outside the tentacle and looks like a third, thick tentacle-scale on the first 3 or 4 arm-segments.

TEXT-FIG. 28.



TEXT-FIG. 29.



TEXT-FIGS. 28, 29.—*Amphiomya notabilis* sp. nov. FIG. 28.—Dorsal view of half the animal. $\times 20$.
FIG. 29.—Oral view of mouth parts, 2 arm-bases and an interbrachial area. $\times 20$.

Oral shields diamond-shape, longer than wide, the proximal angle acute, the others rounded; madreporite conspicuously swollen, with all angles rounded. Adoral plates large, meeting broadly within, where they are only a little less wide than at the outer end, where they meet the first under arm-plate and side arm-plates. Oral papillæ, notably thick, arranged as in *Amphipholis*; a high block-like pair at tip of jaw; a second papilla

of about equal width on side of jaw and a third distal papilla fully twice as wide as long, its width equalling or exceeding the two proximal papillæ. Teeth not visible. Colour pale greyish white.

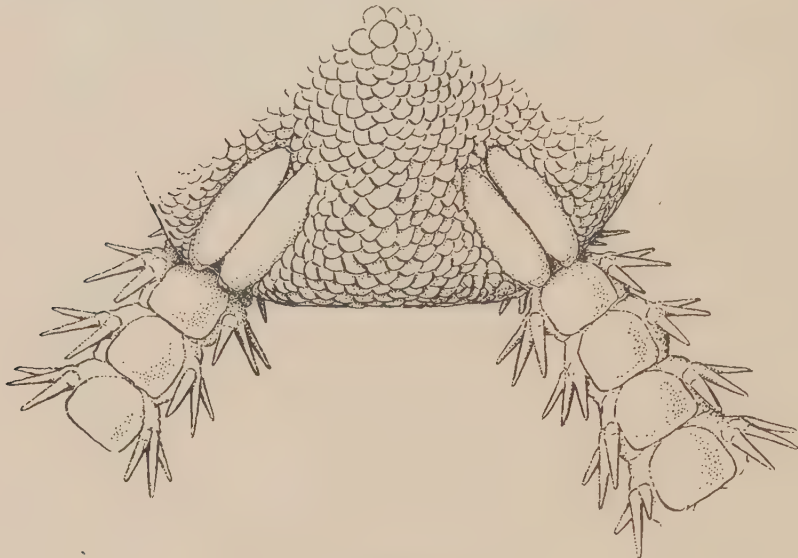
REMARKS.—It is, of course, most regrettable that this unique specimen has no locality label. From its general structure and appearance, it is a shallow-water form, and it is not unlikely that it came from the Maldive area, where considerable shallow water collecting was done. Its relationship to *Amphipholis* is, of course, obvious.

AMPHIODIA MINUTA* sp. nov. (Text-figs. 30 and 31.)

LOCALITY.—Station 142B; Maldive area; 37 metres. Two specimens.

DESCRIPTION.—Disk 2.5 mm. in diameter, nearly circular, almost flat. Arms 5,

TEXT-FIG. 30.



TEXT-FIG. 31



TEXT-FIGS. 30, 31.—*Amphiodia minuta*. $\times 30$.

exceedingly long and slender; all are broken, but one is fully 25 mm. long and shows only a little attenuation at the broken tip; there is little doubt that in life the arms were

* *minutus* = very small, of obvious application.

fifteen times the disk diameter. Disk covered by a very close coat of minute overlapping scales, with no indication of primary plates. Radial shields small, half a millimetre long, in closely appressed pairs; each pair in hardly one-third of a millimetre wide. Upper arm-plates large, broadly oval, wider than long, the distal margin somewhat convex, the proximal angle rounded; they are in contact basally, but become more or less separated distally by the side arm-plates.

Interbrachial areas, closely covered, like the disk, with small overlapping scales; genital slits large. Under arm-plates oblong, the first relatively large, about one-half the second, with which it is in contact; succeeding plates about as wide as long, but soon becoming distinctly longer than wide, with concave lateral margins and rounded angles; they are more or less in contact until well out on the distal part of arm. Side arm-plates small; each carries 3 slender acute spines, of which the middle one is stoutest and slightly exceeds the arm-segment; the lowest is as long but more slender, the uppermost is evidently shorter. Tentacle-scale single, small and rounded, placed near the middle of the lateral margin of the under arm-plate; it is clearly developed only on the basal arm-segments, and is apparently wanting distally.

Oral shields oval, longer than wide, widest distally, the inner end a rounded point, the outer somewhat truncate. Adoral plates indistinct, so that it is difficult to determine their true form; the outer portion is triangular, with a point touching the first under arm-plate and the outer side resting against the side arm-plate; apparently they do not meet within, though in some cases the proximal portion extends inwards along the oral shield. Oral papillæ as usual in Amphiodia, but notably thick and stout; the innermost pair are bigger than the second; the outermost are widest and most flattened and scale-like; they have a rounded margin; the three of any one side of a jaw are in close contact with each other. Teeth of moderate width, with slightly concave margin. Colour (dry) pure white.

REMARKS.—The second specimen is diskless, but in other respects is just like the holotype. They have every appearance of being adults, and not the young of a larger species. The radial shields, oral shields and excessively long arms are distinctive.

AMPHIOPLUS HASTATUS (Ljungman).

Amphipholis hastata Ljungman, 1867, p. 313.

Amphioplus hastatus H. L. Clark, 1915, p. 257. Koehler, 1926, pl. 3, figs. 2 and 3.

LOCALITIES:

Station 45; South Arabian coast; 38 metres. Seven specimens.

Station 89; northern area of Arabian Sea; 135–183 metres. One specimen.

Station 206; Red Sea; 256 metres. One specimen.

Station MB IIc; South Arabian coast; 29 metres. One specimen.

RANGE.—Mozambique and East Indies near Ceram and Banda, in shallow water.

NOTES.—All of the specimens are small and many are in poor condition, but they show the species characters well. The largest is from Station 206 and measures a full 5 mm. across the disk; it is therefore the largest specimen yet taken; unfortunately the arms are all broken near the disk. The specimen from Station MB IIc is the smallest, but is in excellent condition; the disk is less than 2 mm. across, while the slender arms

JOHN MURRAY EXPEDITION

are fully 10 mm. long. The remaining specimens are 3–3.5 mm. across the disk, but the only one with an arm even approximately whole is diskless !

REMARKS.—Koehler (1926, p. 16) states that the specimens taken by the “Siboga” were “parfaitement identique” with one of Ljungman’s types with which he compared it, so it is evident that the species ranges from Mozambique to Banda. It is not strange, therefore, that the “Mabahiss” met with *hastatus* in her dredging, but it is odd that all of the material came from the northern part of her collecting field, and no specimens were met with in the Zanzibar area. Since it is a shallow water species, the reverse might have been expected.

OPHIACTIS CARNEA Ljungman.

Ophiactis carnea Ljungman, 1867, p. 324. Mortensen, 1933a, p. 343, fig. 54.

LOCALITIES :

Station 45 ; South Arabian coast ; 38 metres. Ninety-three specimens.

Station 53 ; South Arabian coast ; 13.5 metres. Two specimens.

Station MB IIa ; South Arabian coast ; 11 metres. Five specimens.

RANGE.—Coast of South Africa, low-water mark to 225 metres.

NOTES.—The specimens from Stations 53 and MB IIa are very young with disk-diameters of 1 to 2.5 mm. The series from Station 45, however, is a very diversified lot of material. It was included under 13 lot numbers (Op. 14, 15, 33, 88, 101, 113, 119, 124, 140, 142, 156, 166, 191) with “notes” in half a dozen cases, indicating how large an amount of bottom material (sponges, alcyonarians, etc.) was secured at Station 45, and how patiently it was sorted out. The habitat of this little brittle-star is, like that of several other species of the genus, in the crannies and cavities of colonial organisms on the bottom in shallow water, and its secretive habits are characteristic of most of the species of *Ophiactis*. The specimens from Station 45 range from less than 2 mm. across the disk to about 5 mm., and the identification of the smaller ones is, of course, not beyond question. All but one are variegated with light and darker shades of greyish or brownish green. The one exception is obviously artificially stained with a purplish red ; possibly it was preserved originally with a red-purple comatulid.

REMARKS.—It is most interesting to find this characteristic South African brittle-star on the South Arabian coast, especially as it was not taken in the Zanzibar area. Probably it occurs along the whole western coast of the Indian Ocean, wherever local conditions are suitable.

OPHIACTIS PLANA Lyman.

Ophiactis plana Lyman, 1869, p. 330. Mortensen, 1933a, p. 346, fig. 57.

LOCALITIES :

Station 24 ; Gulf of Aden ; 73–200 metres. Five specimens.

Station MB Ib ; Red Sea ; 29 metres. Three specimens.

Station MB Id ; Red Sea ; 26 metres. Eight specimens.

Station ? ; One specimen.

RANGE.—Widely distributed in warmer seas around the world from shallow water to great depths (over 2000 metres).

NOTES.—The “Mabahiss” specimens are all small, less than 2 mm. across the disk,

with 6 arms and, with one or two exceptions, show evidence of recent division. The colour shows some diversity, for while all are more or less variegated, those from Station 24 and MB Ib are light-coloured with a greenish tint, the one from an unknown station is much darker, and those from Station MB Id have a distinctly reddish tint.

REMARKS.—This material throws little light on the perplexing questions concerning this species which has been described under several different names. Mortensen (1933a, p. 346) after study of South African material concludes that “on the whole, it does seem that *O. plana* is a cosmopolitan species like *Ophiactis Savignyi*”. I quite agree with this conclusion, and I believe *O. parva* Mortensen from the Suez Canal is a synonym of *plana*, but without having a specimen of *parva* to compare with the present lot from the Red Sea and Gulf of Aden, I hesitate to assert it.

OPHIACTIS SAVIGNYI.

Ophiolepis savignyi Müller and Troschel, 1842, p. 95.

Ophiactis savignyi Ljungman, 1867, p. 323.

Ophiactis reinhardtii Lütken, 1859, p. 161; pl. 3, figs. 7a, b.

LOCALITIES :

Station 133; Zanzibar area; 220 metres. One specimen.

Station MB Ib, c, d; Red Sea; 26–29 metres. Eighteen specimens.

RANGE.—Cosmopolitan in all warm seas, from low-water mark to about 100 metres.

NOTES.—The specimens at hand are all young and most of them are 6-rayed, and show evidence of recent division. One of the larger specimens (2.5 mm. across disk) is of interest, as it has but 5 rays, and 2 of the arms are much smaller than the other 3, demonstrating the origin of a 5-armed adult by schizogony. Mortensen (1933b, p. 447) says he has never seen such a specimen.

REMARKS.—There is nothing notable about the occurrence of *savignyi* in either the Zanzibar area or the Red Sea, but it is of interest to note that it and *O. plana* occurred at the same station.

OPHIACTIS HEXACANTHA* sp. nov. (Text-figs. 32 and 33.)

LOCALITIES :

Station 164; Maldive area; 183 metres. One specimen.

Station MB Ib; Red Sea; 29 metres. One specimen.

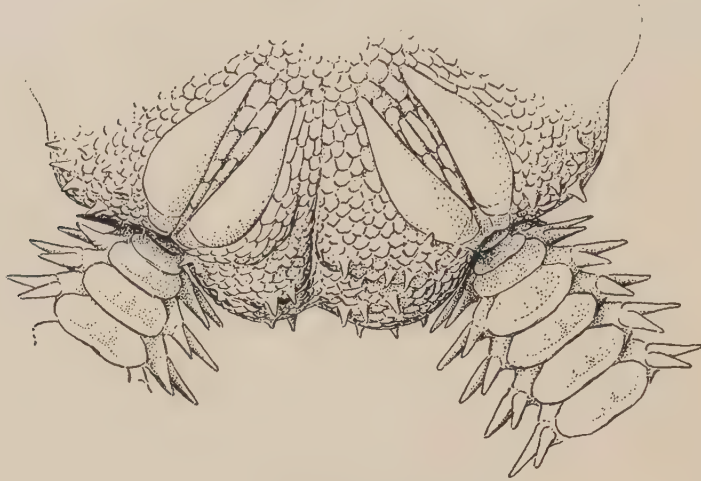
DESCRIPTION.—Disk 6 mm. in diameter, rounded decagonal, with concave radial, and notched interradiial sides. Arms 5, not very stout apparently, but all are broken, and of only one is enough left to yield any data. Disk covered with thin, ill-defined scales and large radial shields; many interradiial plates near disk margin bear low, rather slender, but not very acute spinelets, but these are lacking on the disk elsewhere. Radial shields notably large, 1.75 mm. long by .60 mm. wide just distal to middle; inner margins straight, in contact at distal tip, but divergent and well separated within; outer margins convex. Upper arm-plates elliptical, with rounded lateral margins, about three times as wide as long, very broadly in contact.

Interbrachial areas below covered by rather large, thin, overlapping scales, a few of which carry spinelets. First under arm-plate small, nearly square with rounded corners;

* ξξ = six + ἄκανθα = spine, in reference to the numerous arm-spines.

succeeding plates much larger, longer than wide with rounded corners and slightly concave lateral margins; beginning with the fourth, the plates are as wide as long, or even a little wider, the distal margin is quite convex and longer than the proximal, which is nearly straight; the lateral margins are only a trifle concave, and all corners are much rounded; the surface of the plate is not smooth and flat, but is depressed on each side, so that the midline and lateral margins, and especially the distal margin, appear to be thickened.

TEXT-FIG. 32.



TEXT-FIG. 33.



TEXT-FIGS. 32, 33.—*Ophiactis hexacantha* sp. nov. FIG. 32.—Dorsal view of part of disk and two arm-bases. $\times 16$. FIG. 33.—Oral view of same. $\times 16$.

Side arm-plates rather small, not meeting either above or below; each carries a series of 6 or even 7 spines, at right angles to the arm; lowest spine shortest, thick, somewhat flattened and rounded at tip, so it resembles the closely adjoining tentacle-scale, but is larger; next spine similar, but larger; the next is narrower, thicker, a little longer and more pointed; the fourth is definitely more spine-like, longer and more pointed; the fifth is longest, but not quite equal to width of arm, somewhat thorny (under considerable magnification) near tip, which is truncate, with a hyaline tooth on each side; sixth (usually uppermost) spine noticeably shorter than fifth, more flattened and more nearly pointed; when present the seventh spine is like the sixth, but considerably smaller. Tentacle-scale

single, large, flat, but thick, rounded, notably like the lowest arm-spine, but smaller. Oral shields small, wider than long, rounded diamond-shape, but outlines not very distinct; madreporite definitely largest. Adoral plates relatively large, meeting within; those associated with madreporite are elongated and much narrower within than at the radial end; the others are about equally wide at the two ends; the radial ends abut on the first under arm-plate. Oral papillæ, 2 on each side, small flat and rounded at tip; usually the inner is narrower and smaller than the outer, but in one case it is distinctly the larger. Teeth wide, with slightly irregular or notched margin; lowest (infradental papilla) narrower and smaller than the true teeth. Colour (dry) above very pale brown; distal tips of radial shields and the spinelets nearly white, as is the oral surface.

REMARKS.—The single adult specimen from Station 164 is in such poor condition it is unfortunate to have to make it the type of a new species in so perplexing a genus, but the large radial shields, thin disk-scales, paired oral papillæ and peculiar under arm-plates and lower arm-spines are very definite distinguishing marks. The specimen from the Red Sea is very small, not quite 1.5 mm. across the disk, with arms about 10 mm. long. It was found with *plana*, *savignyi* and *versicolor* and was first considered a young *plana*, but more critical study revealed the pairs of distal, oral papillæ, the thin disk covering and large radial shields, and 5 arm-spines on the basal arm-segments with the lowest ones like the big tentacle-scales. There seems no doubt therefore that the specimen must be considered a young individual of *hexacantha*.

OPHIACTIS SPINULIFERA* sp. nov. (Text-figs. 34 and 35.)

LOCALITIES :

Station 139; Maldivé area; 57 metres. One specimen.

Station 144; Maldivé area; 31 metres. Two specimens.

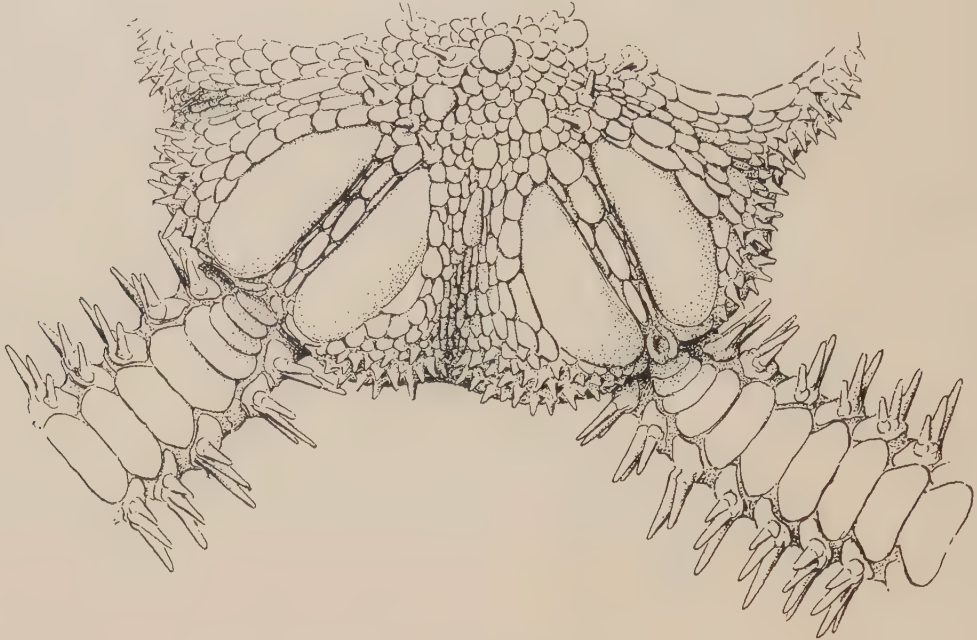
DESCRIPTION.—Disk 6 mm. in diameter, rounded pentagonal with interr radial notches. Arms 5, moderately stout and very long; all are broken, but of one, 50 mm. is still present, and it undoubtedly exceeded 60 mm. in life. Disk covered with a coat of thick, rather coarse scales of varied form, more or less overlapping, a very few of which bear spinelets of moderate size; on the interr radial margins the scales become very small and nearly all bear relatively stout but small, acute spinelets. Radial shields very large, nearly 2 mm. long and a millimetre wide distal to middle; inner margins straight and diverging from the distal end where they are nearly but not quite in contact; outer margins curved on the proximal half and distally very convex. Upper arm-plates broadly elliptical with rounded lateral margins, about 2.5–3 times as wide as long, very fully in contact.

Interbrachial areas below so densely covered with spinules that the scales are visible only along the genital slits. First under arm-plate nearly triangular, wider than long, separated from second by the adoral shields. Succeeding plates wider than long, more or less oblong with rounded corners; at first they are fully in contact, but distally this is less marked, the amount of contact depending on the flexure of the arm. Side arm-plates low and rather small, but each bears 6 or 7 conspicuously projecting spines; the lowest is shortest and smallest, somewhat club-shaped, not at all like the tentacle-scale; the next two or three are successively longer and about as stout, the fourth being the longest and stoutest of all; above it is a much more slender and acute spine, not quite as long; the

* *spinuliferus* = bearing minute spines, in reference to the character of the interbrachial areas below.

sixth is similar, but shorter, and the seventh, if present, is still shorter. Tentacle-scale single, large, rounded and scale-like, not at all like the lowest arm-spine.

TEXT-FIG. 34.



TEXT-FIG. 35.



TEXT-FIGS. 34, 35.—*Ophiactis spinulifera* sp. nov. FIG. 34.—Dorsal view of part of disk and bases of 2 arms. $\times 15$. FIG. 35.—Oral view of same. $\times 15$.

Oral shields large, somewhat trefoil-shaped (madreporite largest, broadly oval without notches) wider than long; distal side slightly prolonged to join the interbrachial area. Adoral plates small, more or less triangular, not meeting within but lying at the sides of the oral shield; the outer distal corner extends in between the first and second arm-plate, separating them, but not quite reaching its fellow in the midline. Oral papilla single,

large, thick and rounded, but higher than wide, located on the oral plate and not on the adoral. Teeth wide but short, the lowest (infradental papilla) the smallest. Colour (dry) very light, nearly a cream-white, with dusky markings on the upper arm-plates; these tend to form a broad but ill-defined band on the upper side of the arm.

REMARKS.—This is one of the best-defined species in the genus, and quite unlike any previously described. The paratypes are a little smaller than the one described, but differ from it in no important particular. The dusky markings on the upper side of the arms are not evident however. The long arms, big radial shields, large oral papillæ located at middle of jaw and the spiniferous interbrachial areas are distinctive characters. Although the arm-spines are as numerous as in *hexacantha*, their size and form are very different.

OPHIACTIS VERSICOLOR* sp. nov. (Text-fig. 36.)

LOCALITY.—Station MB Ib; Red Sea; 29 metres. Four specimens.

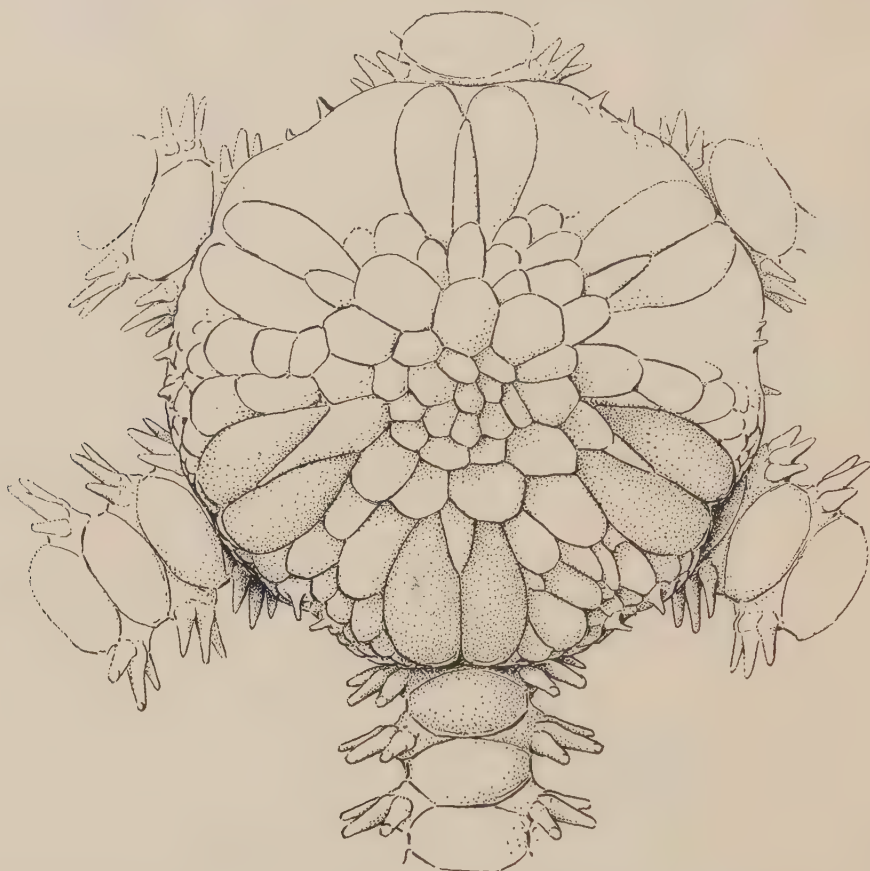
DESCRIPTION.—Disk 3 mm. in diameter, flat and nearly circular. Arms 6, about 10 mm. long, relatively stout, attenuate only near tip. Disk covered by relatively large plates and radial shields; the plates are largest near centre of disk and become very small at interradial disk margins; spinules are present only on these minute marginal plates. Radial shields nearly .75 mm. long, about half that in width, in contact distally, but diverging from that point and well separated proximally; convex on outer side, straight on inner. Upper arm-plates much wider than long, widest distal to middle, narrowest at proximal margin, which is in full contact with previous plate; lateral margins, with rounded angles just distal to middle where plate is widest, proximal to which the margin is a little oblique but straight.

Interbrachial areas below covered with small scales, many of which carry minute spinules. Under arm-plates nearly square, with rounded angles, fully in contact; distal margin only a trifle longer than proximal, lateral margins very slightly concave; first under arm-plate small, triangular or possibly pentagonal, separated from second plate by the adoral plates; although the latter do not quite meet. Side arm-plates small, carrying but 4 short, stout, blunt spines in a bristling vertical series; lowest is shortest and stoutest, the next is a little longer, the third is longest, but little exceeds the arm-segment and does not nearly equal arm-width; the fourth and uppermost is about as long as the second, but not so stout. Tentacle-scale single, large, flat, rounded, rather longer than wide.

Oral shields rounded triangular or somewhat diamond-shaped, wider than long; madreporite largest and least angular. Adoral plates rather large, more or less triangular with rounded angles, not meeting within or without, but tending to keep the first and second under arm-plates separated. Oral papilla single, flat, rounded and scale-like, rather longer than wide, situated on the inner end of the adoral plate. Teeth not very wide, but stout. Jaw very short, so that the lowest tooth (infradental papilla) is nearly between the two oral papillæ and seems almost to rest on the inner tip of the oral shield, as though there were no oral plates. Colour of disk of dry specimen, mixed light and dark green of an olive tint with an irregular blotch of dull red at centre; upper arm-plates prettily variegated with green, red and dirty whitish; on some plates the green greatly predominates, and on others the red, so that the arm is irregularly and indefinitely banded with green and red; arm-spines and oral surface dingy white or pale greyish brown.

* *versicolor* = variegated, in reference to the diversified coloration.

REMARKS.—This prettily-coloured species is distinguished from the other species of *Ophiactis* in the collection by the rather coarse disk covering and relatively large but narrow radial shields, the short jaws, the few short, thick arm-spines and the squarish under arm-plates. In the type and one paratype (2 mm. across disk) the green and red coloration is distinctive, but in the two other paratypes, which are very young, it is not sufficiently developed. The disk scaling and upper arm-plates prevent confusion with *plana* however. It is remarkable that in nearly all structural details this species is very close to the West Indian *mülleri* (*cyanosticta* H. L. Clark, see Mortensen, 1933*b*, p. 447),



TEXT-FIG. 36.—*Ophiactis versicolor* sp. nov. Dorsal view of disk and arm-bases. $\times 20$.

but the arm-spines are shorter and more stumpy and the under arm-plates more nearly square. The coloration is, of course, totally different.

OPHIODAPHNE MATERNA Koehler.

Ophiodaphne materna Koehler, 1930, p. 129; pl. 16, figs. 3-8.

LOCALITY.—Station MB IIc; Arabian coast; 29 metres. One specimen.

RANGE.—Kei Islands and North-western Australia, 10-245 metres.

NOTES.—This single specimen is little more than a millimetre across the disk, but it is so well preserved there is no doubt of its generic position. After comparison with the *Ophiodaphnes* at hand, it seems best to consider it a young female of *materna*, though it is

not at all unlikely sufficient material would show that the Arabian species is quite distinct. The colour of the "Mabahiss" specimen is a very pale grey, quite different from the yellowish-brown shade of the East Indian species.

REMARKS.—Mortensen (1933, p. 183) has shown that the small individual carried over her mouth by the adult *Ophiodaphne* is not her young as supposed by Koehler, but is really a complementary male. The specimen which the Museum of Comparative Zoölogy received most generously from Dr. Mortensen carries such a male; it is only a little smaller than the "Mabahiss" specimen. But it is interesting to note that the disk covering of the Arabian ophiuran is not much like this male, but is much more like that of the adult female. It seems probable therefore that this specimen is a young female, and not a male that has been torn loose from his partner. The extension of range of *Ophiodaphne* by the discovery of this minute individual on the Arabian coast is very extraordinary, and emphasizes again our ignorance of the actual distribution of what we call the Indo-Pacific fauna.

Family OPHIOTRICHIDÆ.

OPHIOTHRIX DEMESSA Lyman.

Ophiothrix demessa Lyman, 1861, p. 82. Koehler, 1905, pl. 9, figs. 5 and 6.

LOCALITIES :

Station 27; Gulf of Aden; 37–91 metres. One specimen.

Station MB 1c; Red Sea; 26 metres. One specimen.

RANGE.—Red Sea and Madagascar to Hawaiian Islands, in shallow water.

NOTES.—Both of these specimens are the pink form of this well-marked species. The disk is nearly white in the dry specimens, while the arms are banded with pink and light but dusky purple. The specimen from Station 27 is 10 mm. across the disk; the other is only half as large.

REMARKS.—Koehler (1907, p. 332) has already recorded this species from the Red Sea, so its presence in the "Mabahiss" collection is not surprising.

OPHIOTHRIX OTIOSA Koehler.

Ophiothrix otiosa Koehler, 1898, p. 99; pl. 3, figs. 17–19.

LOCALITIES :

Station 10; Red Sea; 55 metres. Three specimens.

Station 45; South Arabian coast; 38 metres. One specimen.

Station MB 1b; Red Sea; 29 metres. Twenty-three specimens.

Station MB 1d; Red Sea; 26 metres. Twenty specimens.

RANGE.—Malabar coast, 65 metres.

NOTES.—The great majority of these specimens are very small (1–3 mm. across disk) and would be quite unidentifiable were it not for their association with the larger specimens (5–6 mm.), several of which answer well to Koehler's description. There is great diversity in colour, as usual in *Ophiothrix*, but a number are nearly "uniformément rosee", as described. Several, however, notably the one from Station 45, are very light, a pale greyish purple with the spines white. Many specimens, but not all, have a distinct narrow

longitudinal light stripe on the upper side of the arm; in the light-coloured individuals this is bounded by a very narrow purplish line. Since Koehler had only two specimens it is not strange he failed to note any diversity of colour. In one other detail these specimens show a diversity not evident in Koehler's; the surface of the disk carries long, very slender spines among the thorny cylinders which cover it densely; in one large specimen there are only 2 or 3 of these spines, but in other cases they are conspicuously numerous. Probably they are sometimes entirely wanting as they seem to have been in Koehler's types.

REMARKS.—It is not surprising to find this species, originally taken on the Malabar coast, common in the Red Sea, but it seems very probable that it is really identical with *O. savignyi* M. & T. to which Mortensen (1926, p. 121) unceremoniously assigns Koehler's species *beata* (1907, p. 330). Oddly enough Koehler makes no reference to *otiosa* in his account of *beata*, and yet a comparison of his descriptions and figures fails to reveal any other notable difference than the presence of the slender disk-spines in *beata*, and these apparently may occur in *otiosa*. There is a curious slip of the pen in the original description of the latter (line 4 from bottom of p. 99), where Koehler has written "boucliers radiaux" for "boucliers buccaux".

OPHIOTHRIX AMPHIBOLA* sp. nov.

LOCALITY.—Station 106; Zanzibar area; 183–194 metres. Two specimens.

DESCRIPTION.—Disk 4 mm. in diameter, rounded pentagonal, flat. Arms 5, short, none is entire but they did not exceed 18 mm. in life. Disk covered by large radial shields and numerous very small scales; many scales carry low trifid stumps, which are not numerous enough to form a real covering to the disk; the 3 terminal thorns are not very long, about equal to the short stump itself; here and there among the stumps is a slender spinelet. Radial shields very large and bare; there are stumps along the margin, and rarely one or two on the surface. Upper arm-plates diamond-shaped with rounded angles, at first wider than long, but becoming longer than wide; distal angle considerably swollen, proximal flat and truncate; the plates are barely in contact on basal half of arm, but become separated distally.

Oral surface and mouth parts as usual in the genus, not distinctive. Under arm-plates squarish, wider than long, with rounded corners, fully in contact on base of arm; distally the proximal end becomes a little narrower and the plates much longer than wide, remaining fully in contact. Arm-spines few, short, relatively thick, blunt and coarsely thorny; there are 4 or 5 in each series, with the upper one or two longest, but not exceeding the arm-width. Tentacle-scale insignificant. Oral shields much wider than long, with small adorals lying on their inner side, as is usual in *Ophiotrix*, not in any way distinctive. Colour (dry) pale grey above, white below; arm-spines not very hyaline, white; distal tips of upper arm-plates more or less white, not conspicuously so, but a characteristic mark.

REMARKS.—The paratype is a little smaller and the disk is yellowish rather than greyish, but the specimens are otherwise very similar. I have sought in vain for a previously described species to which I might refer these insignificant brittle-stars, and I have therefore given them a name, but it has not seemed necessary to give figures, for there isn't a single significant character to be shown. Koehler (1922, pl. 52, figs. 8–10)

* ἀμφιβολος = *doubtful*, in reference to the dubious validity of the species.

gives figures of an *Ophiothrix* which in the explanation of the plate he calls *miles*, but I have been unable to find in index, table of contents, or anywhere else in the text any references to these figures or to the species *miles*, which he described in 1905 from an unknown "Siboga" station (1905, p. 90). The figures of the disk would do fairly well for *amphibola*, but the arm-spines (fig. 9) appear to be quite unlike the Zanzibar species; it is unlikely the two are identical.

PLACOPHIOTHRIX ARISTULATA (Lyman).

Ophiothrix aristulata Lyman, 1879, p. 50; pl. 15, figs. 421-424.

Placophiothrix aristulata H. L. Clark, 1938, p. 310.

LOCALITIES :

Station 24; Gulf of Aden; 73-200 metres. Three specimens.

Station 25; Gulf of Aden; 620 metres. One specimen.

Station 43; South Arabian coast; 83-100 metres. Two specimens.

Station 154; Maldiva area; 457 metres. Two specimens.

Station 157; Maldiva area; 229 metres. One specimen.

RANGE.—Cape of Good Hope to Philippine Islands and south to Tasmania, 70-530 metres.

NOTES.—The specimens from Station 154 are beautiful examples of this handsome species, measuring 14 and 17 mm. across the disk. The colour is as usual, the disk white, the arms pinkish (spines white) with a conspicuous longitudinal white stripe along the middle of the upper side; oral surface white. The spines on the disk are relatively short (1-3 mm.) and numerous, but are acicular as usual. The specimen from Station 25 is only 7 mm. across the disk and the pink colour has a violet tinge; the whole disk is faintly tinted with it. In other details this individual is typical. But the specimen from Station 157 is of somewhat dubious authenticity, for it is only 4.5 mm. across the disk, and in such poor condition that satisfactory identification is impossible. A note accompanying it states that it was taken from branches of an "alcyonarian of *Nicella* type". The specimens from Stations 24 and 43 are even smaller, only 2-3.5 mm. in disk diameter, and lack any distinctive colour, but they may, I feel very sure, be properly considered very young individuals of *aristulata*.

REMARKS.—This handsome brittle-star was first found at the Cape of Good Hope by the "Challenger", but has since been taken by the "Investigator", the "Siboga", the "Albatross", and by Dr. Mortensen in the north and eastern parts of the Indian Ocean. Its range has also been extended southward by the "Endeavour" to Tasmania, and by the "Terra Nova" to New Zealand. It is quite natural therefore that it should have been found by the "Mabahiss" in the Maldiva area, and even in the Gulf of Aden.

PLACOPHIOTHRIX INFIRMA (Koehler).

Ophiothrix infirma Koehler, 1905, p. 89; 1922, p. 241; pl. 48, figs. 5-7.

LOCALITY.—Station 24; Gulf of Aden; 73-200 metres. One specimen.

RANGE.—Sulu Archipelago to Flores and Kei Islands, 50-90 metres.

NOTES.—The present specimen is 6 mm. across the disk and the arms are 35-40 mm. in length. The disk (dry) is a greyish white with pink markings at the tip of the big radial

shields. The arms are white with a pink tinge which is very marked on the spines ; there is no continuous white line bordered with purple as described by Koehler, but the distal half of each upper arm-plate is quite white and on many plates there are dark lines and markings which suggest the last remnants of a dark-bordered white line. On the lower surface of the arm is a definite white line, as shown by Koehler, but on a few plates its boundaries are hazy, and on many it is constricted by a dull brownish pink area on each side.

REMARKS.—In spite of the differences in the coloration of the arms I have no doubt of the identity of the specimen. Whether it should be placed in *Placophiothrix* is more open to question, but the large bare radial shields warrant it, and it is better there than in *Ophiothrix* itself. The occurrence of *infirmus* in the Gulf of Aden is a notable extension of its range.

PLACOPHIOTHRIX PROTEUS (Koehler).

Ophiothrix proteus Koehler, 1905, p. 100 ; 1922, pl. 36, figs. 3 and 4.

LOCALITY.—Station MB II ; Arabian coast ; 11–29 metres. Thirty-four specimens.

RANGE.—New Caledonia and the East Indies to Ceylon, 35–92 metres.

NOTES.—This is a very fine series, ranging from 2.5 to 10 mm. in disk diameter. None shows a trace of red or purple in the coloration, but all have the green and white markings shown by the specimens described by Koehler from “Siboga” Stations 64 and 179. The “Mabahiss” specimens have been compared with a paratype from “Siboga” Station 260.

REMARKS.—This is a well-marked and handsome species whose occurrence on the Arabian coast is of no little interest. The green and white coloration is so distinctive one can but wonder whether two distinct species are not confused under the name *proteus*.

PLACOPHIOTHRIX PURPUREA (von Martens).

Ophiothrix purpurea von Martens, 1867, p. 346. Döderlein, 1896, pl. 17, figs. 23, 23a.

Ophiothrix lepida de Loriol, 1893, p. 38 ; pl. 25, figs. 1–1f.

LOCALITIES :—

Station 10 ; Red Sea ; 55 metres. Four specimens.

Station 24 ; Gulf of Aden ; 73–200 metres. Thirty-two specimens.

Station 27 ; Gulf of Aden ; 37–91 metres. Four specimens.

Station 54 ; South Arabian coast ; 1046 metres. One specimen.

Station 164 ; Maldive area ; 183 metres. Two specimens.

Station MB Ia ; Red Sea ; 29 metres. Four specimens.

Station MB Id ; Red Sea ; 26 metres. Three specimens.

RANGE.—Philippine Islands and East Indies, south to New Caledonia and the Kei Islands, west to Maldive Islands, Mauritius and Madagascar, 7–400 metres.

NOTES.—Most of these 50 specimens are young, ranging from 2 to 5 mm. in disk diameter, and of little significance, but the series from Station 24 is of great value, as many of the specimens are adults (5–9 mm. across disk), and show great diversity in the form of the radial shields and in details of coloration. The specimen from Station 54 shows no peculiarities of either structure or colour associated with the great depth at which it

was taken. Those from Station 164 are also from a greater depth than the usual range of the species; although they are in poor condition, they are typical *purpurea*. The diversity of colour among the 50 specimens is considerable, but it is more of degree than of kind. The disk ranges from a greenish white, with a rosy tint on the distal ends of the radial shields, to a pale grey much marked and variegated with dull crimson or more commonly reddish purple. In nearly all specimens a reddish purple line follows the outline of each radial shield; often this line is incomplete or wanting on the inner margin of each shield; in other cases, additional lines cross the shields irregularly, and in the darkest specimens the whole disk is conspicuously variegated with purplish red and greyish white. The upper arm-spines, or at least their upper sides, are purplish red, dull rose or pink, but the lower spines are colourless. Without exception there is a dark longitudinal line along the middle of the upper arm-plates; in no case is this broken or discontinuous, as it is in some East Indian specimens of *purpurea*. The colour of the line ranges from crimson to deep purple, which is sometimes so dark it might be called black. In some cases there is a more or less definite white line on each side of the dark one, and in two or three specimens a very narrow coloured line limits the outer side of this light area. The oral surface is cream-white, but there is some sort of a longitudinal line along the middle of the under arm-plates in every specimen. This line is usually rusty brown, but it may be darker, approaching brown-purplish; it is usually well-defined on the basal under arm-plates, but is less so distally. In some specimens it is very faint, and occasionally its margins are so much darker than its centre that the appearance is that of two very narrow parallel lines.

REMARKS.—This series of specimens leaves no room for doubt that Koehler (1898, p. 103; 1922, p. 247) is mistaken in attempting to maintain *lepida* as a valid species distinct from *purpurea*. The photographs which he gives (1922, pls. 36 and 58) as showing the distinctive characters of each species can be matched from the material from "Mabahiss" Station 24, and there are sufficiently numerous and satisfactory intergrades to compel us to call them all one species. The difference in the tentacle-scales which Koehler stresses I have not been able to detect in the material available to me.

PLACOPHIOTHRIX ENCARSIA* sp. nov. (Text-figs. 37 and 38.)

LOCALITY.—Station unknown.

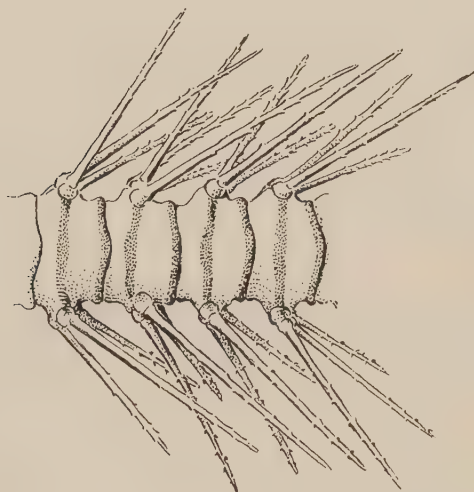
DESCRIPTION.—Disk 3 mm. in diameter; arms 5, about 12–15 mm. long. Disk covered by the large radial shields, a large central plate (indication of immaturity) and an indefinite number of small plates, but the outlines of all are more or less completely obscured by a skin or membrane, which is quite possibly an artefact. Half a dozen of the central plates each carry a long, acicular, but not thorny spine. The interr radial plates at disk-margin carry large thorny stumps. Radial shields large, but the outlines are obscure; apparently each shield is long triangular, reaching two-thirds of the way to centre of disk with the inner margin the base of the triangle, whose height is about one-half its length; all the angles are rounded, especially the distal one; the two shields of each pair seem to be quite separated by 2 or 3 long, narrow scales. Upper arm-plates notably large, but even with the use of benzol, their exact form cannot be made out; apparently they cover the entire upper surface of the arm, but are a little narrower proximally than distally.

* ἐγκάρσια = *transverse*, in reference to the notable coloration of the arms.

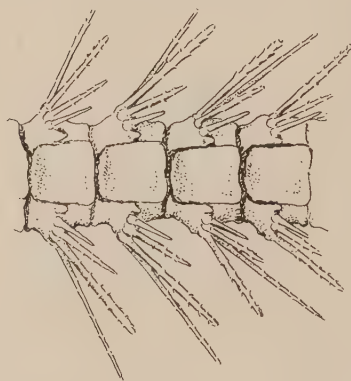
Oral surface as usual in *Placophiothrix*, with oral shields much wider than long, but the outlines of the plates are so obscured by the membranous covering, one cannot be sure of the exact details. Under arm-plates very large, about as wide as long, with corners rounded, nearly covering the lower surface of arm, but apparently not in contact with each other. Side arm-plates very small; each plate carries 4 or 5 slender spines, the uppermost longest, the lowest very small; the uppermost is as long as 3-4 arm-segments, acicular and scarcely thorny; those below are shorter, blunter, a little stouter and more thorny. Tentacle-scale triangular, very small, but relatively rather large.

Colour white, with each radial shield outlined in red-purple, and each arm segment crossed by two narrow transverse lines of the same shade; one of these lines runs from the base of an upper arm-spine to its fellow on the opposite side, and the red-purple colour extends along the upper side of these spines; the other line encircles the arm passing between the under arm-plates.

TEXT-FIG. 37.



TEXT-FIG. 38.



TEXT-FIGS. 37, 38.—*Placophiothrix encarsia* sp. nov. FIG. 37.—Upper surface of four arm-segments to show the transverse striping. $\times 15$. FIG. 38.—Oral surface of same. $\times 15$.

REMARKS.—The specimen upon which this new species is based is undoubtedly young, but its extraordinary arm-plates and conspicuous coloration are specific characters which set it apart sharply from its congeners. It is unquestionably a *Placophiothrix*, allied to *proteus* and *purpurea*, but it cannot be confused with either of them. It is a great pity that there should be no locality known for so remarkably well-characterized a species. The only label with it reads "Op. 11", and in the list of ophiurans, at No. 11 we read "no label".

*PLACOPHIOTHRIX PHRIXA** sp. nov. (Text-figs. 39 and 40.)

LOCALITIES :

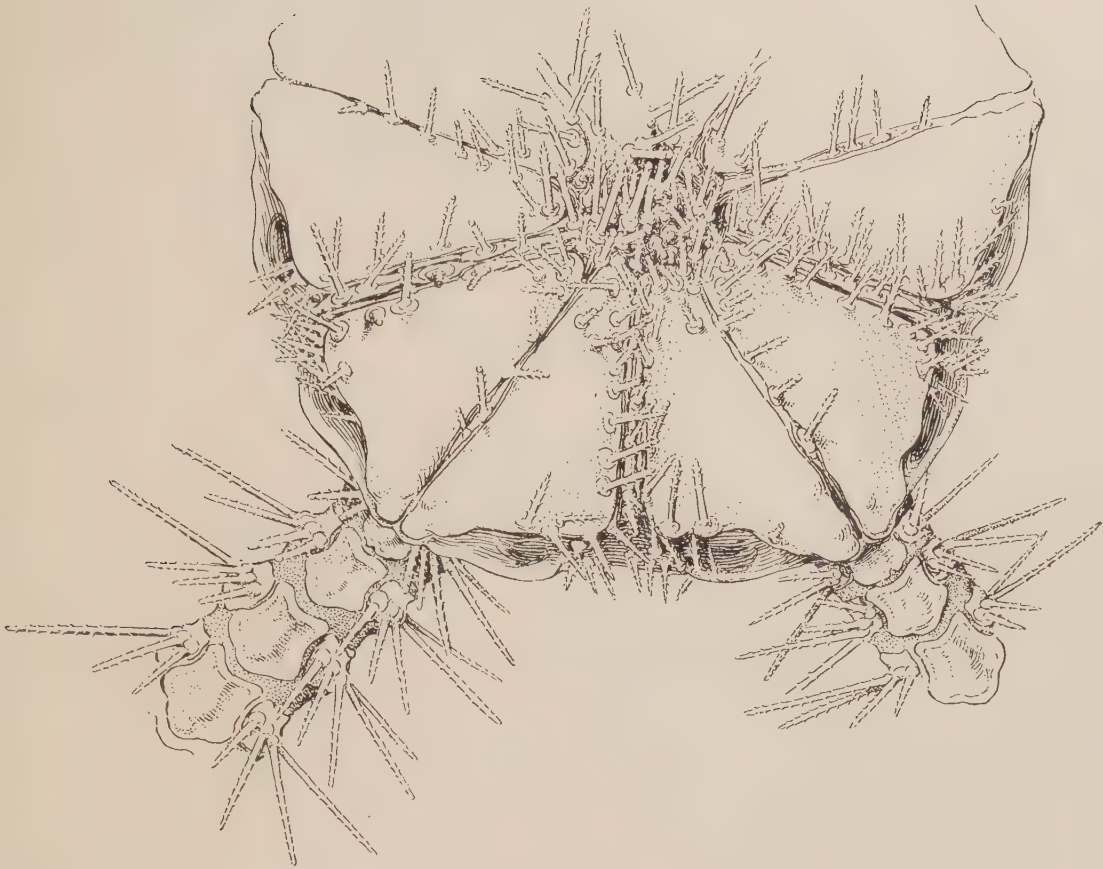
Station 27; Gulf of Aden; 37-91 metres. Four specimens.

Station 45; South Arabian coast; 38 metres. Ten specimens.

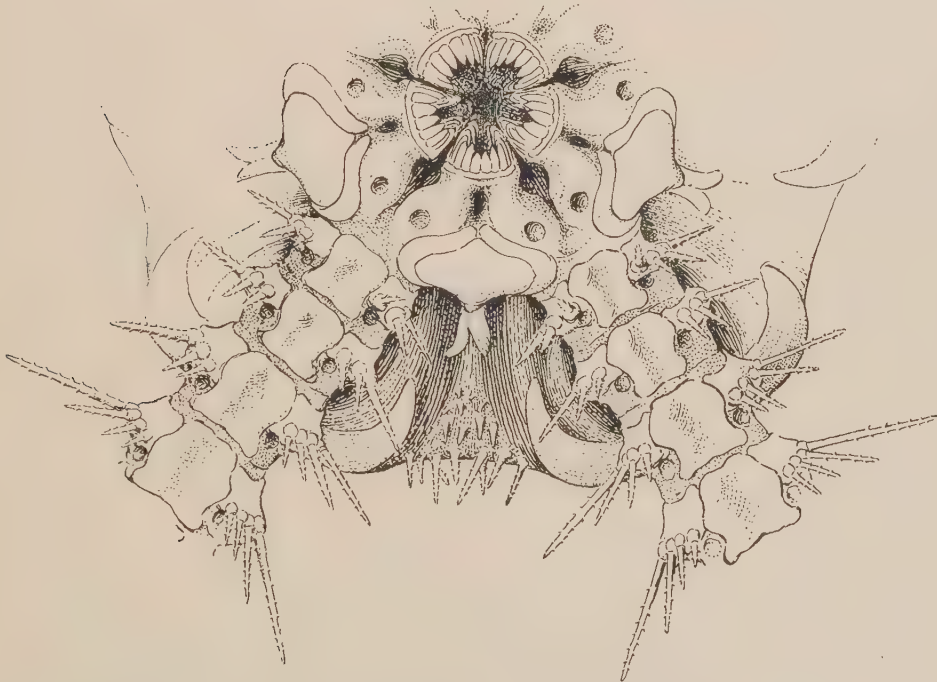
DESCRIPTION.—Disk 7 mm. across; arms 5, all broken, but to judge from all the specimens, they were probably not less than 50 mm. long in life. Disk almost wholly

* $\phi\omicron\rho\iota\xi\acute{o}\varsigma$ = *bristling*, in reference to the numerous spines on the disk and arms.

TEXT-FIG. 39.



TEXT-FIG. 40.



TEXT-FIGS. 39, 40.—*Placophiothrix phriza* sp. nov. FIG. 39.—Dorsal view of most of disk and two arm-bases. $\times 15$. FIG. 40.—Oral view of same. $\times 15$.

covered by the radial shields; centre of disk, narrow interbrachial areas and very narrow radial areas between the two shields of a pair, covered by a thin skin which bears very small and not at all crowded plates, most of which carry, each, a long acicular, but more or less thorny spine; similar spines occur in numbers on the interrachial and distal margins of the radial shields. Interrachial margins of disk with many similar but somewhat smaller spines. Upper arm-plates pentagonal, about as wide as long; all angles rounded; proximal margin concave or distinctly notched; distal angle with a conspicuous knob, the thickest and most elevated part of a median keel or ridge which is scarcely evident at proximal end of plate; plates not in contact with each other, but more or less noticeably separated by thin, naked skin.

Interbrachial areas below covered by thin skin, which is nearly naked, but carries near the disk margin some very small plates, each of which, as a rule, bears a tiny spinelet; genital plate and genital scale very conspicuous. Under arm-plates slightly separated from each other by naked skin, more or less hexagonal (or pentagonal) with rounded angles, apparently longer than wide, but the difference is slight; centre of plate thinner than margins and a little depressed, giving the appearance of a longitudinal stripe along middle of lower surface of arm, but there is no pigment involved. Side arm-plates narrow, well separated from each other by naked skin; each plate carries 5 (near base of arm 6 or even 7) arm-spines, of which the uppermost are very long and slender, nearly equalling 3 arm-segments; these spines are not very thorny, but are not perfectly smooth, and they are not noticeably sharp-pointed; the spines decrease in length ventrally very rapidly, and the lowest is minute. Tentacle-scale generally wanting, but may be present, though very minute, on the basal pores of the arm.

Oral shields elliptical or rounded diamond-shape, twice as wide as long, or even wider. Adoral plates exceedingly narrow, about four times as long as wide, practically, but not quite, meeting within. Oral papillæ wanting of course, and teeth as usual in the family.

Colour (dry) of all calcareous parts white; of the naked skin, brown of some shade, darkest on interbrachial areas below and lightest on sides of arms distally. Every third or fourth upper arm-plate has the proximal half (rarely it is the distal end) faintly outlined in red-purple and lightly tinted with that shade. In some of the very young specimens this red-purple tint is so marked that the arms are distinctly banded and even on the disk—especially the radial shields, a pink coloration is perfectly evident. In some of the young, however, there is no more pigment than in the adults. In one specimen it is distinctly violet, with no hint of red.

REMARKS.—This is a very satisfactory series of specimens, ranging from 2 to 9 mm. in disk diameter. The specimens from Station 27 are all young, but are unmistakable. The huge radial shields, the exceptional amount of uncalcified skin, the numerous disk-spines, and the character of the arm-plates serve to distinguish this species from any of its near relatives.

OPHIOTRICHOIDES PROPINQUA (Lyman).

Ophiotrix propinqua Lyman, 1861, p. 83. Koehler, 1922, pl. 38, figs. 1 and 2.

LOCALITY.—Station MB 1b; Red Sea; 29 metres. Two specimens.

RANGE.—From Zanzibar to the Gilbert Islands, from low-water mark to 54 metres.

NOTES.—The smaller specimen (3 mm. across disk) has little red in the coloration, only an occasional upper arm-plate being somewhat reddish; the disk and most of the upper arm-plates are distinctly dull blue and cream colour. But the larger one (5 mm. across disk) has the disk dull rose-red and cream colour, while the upper arm-plates alternate irregularly between rose and cream colour and dull blue and cream colour. This specimen has more red than any other specimen I have seen.

REMARKS.—The occurrence of this species in the Red Sea is not surprising, but its discovery there is an interesting extension of its range.

MACROPHIOTHRIX BREVIPEDA H. L. Clark.

Macrophiothrix brevipeda H. L. Clark, 1938, p. 290, fig. 20.

LOCALITIES :

Station 45 ; South Arabian coast ; 38 metres. Twenty-eight specimens.

Station 53 ; South Arabian coast ; 13·5 metres. Twenty-six specimens.

RANGE.—Coast of Natal, 45–90 metres.

NOTES.—This is indeed a notable series of this recently described and little known species. The specimens range from 3 to 13 mm. across the disk, and hence show a complete series of growth changes. But there is surprisingly little diversity, for all are definitely blue and white, though the largest has the disk more pale brown, and some of the smaller specimens tend the same way. In all, the white longitudinal stripe of the upper side of the arm is noticeable and that on the under arm-plates is equally well marked. The short arms are a striking characteristic, for they are only 5–6 times the disk diameter, and thus belie the generic name. But the general appearance is so like *longipeda* and its allies that there is no doubt of the generic position.

REMARKS.—The discovery of this species, hitherto known only from Natal, off the South Arabian coast, is indeed a notable extension of range, but there is no doubt of the identity of the species, for in the recently published key to *Macrophiothrix* (H. L. Clark, 1938, p. 280) these specimens run down to *brevipeda* without any difficulty, and comparison with the holotype of that species shows they are identical. The only difference is that the Arabian specimens are definitely blue and white, while the Natal specimens have little indication of blue, except for a hint of it on the upper arm-plates of the holotype. Apparently *brevipeda* is an East African species reaching the southern limit of its range on the coast of Natal, and its northern on the Arabian coast. Further study of *Macrophiothrix* from East Africa, Mauritius and Madagascar is greatly to be desired.

OPHIOTHELA CÆRULEA H. L. Clark.

Ophiothela cærulea H. L. Clark, 1915, p. 283 ; pl. 14, fig. 1.

LOCALITIES :

Station 45 ; South Arabian coast ; 38 metres. Two hundred and eleven specimens.

Station 53 ; South Arabian coast ; 13·5 metres. Twenty-five specimens.

Station MB IIa ; South Arabian coast ; 11 metres. One specimen.

Station MB IIc ; South Arabian coast ; 29 metres. Five specimens.

RANGE.—Known previously only from the holotype, which was taken in the Arabian Gulf in April, 1861.

NOTES.—This bewildering array of more than two hundred specimens shows that the holotype was an abnormal or possibly a young individual, for it had 6 arms, and in the present series there are but 2 hexamerous specimens, and these are very young, with the disk but 2 mm. in diameter. Moreover adults of this species attain as much as 7 mm. across the disk and the arms are 4–5 times as much. The coloration is so amazingly varied that no two specimens are exactly alike. Nearly all show more or less blue, so that the name is not inappropriate, but many have more or less red or violet and a few are wholly light brown, greenish and white or cream colour. There is equally great diversity in the armature of the disk; in some individuals the huge radial shields are smooth and unarmed, and only a few low, pointed tubercles are to be found on the disk margin; at the other extreme are those in which the whole disk, radial shields and all, is covered, though not closely, with spinelets, pointed tubercles, granules and even thorny, pointed stumps. This is in no sense a matter of age or size.

REMARKS.—This long series of *Ophiothelas* raises anew the question as to how many of the nine or ten named species are really valid. The anatomical characters of the genus have never been well worked out, and just what features may be valid as specific characters is yet to be shown. But there is, I think, no doubt that the present series represents but one species, and that the one first taken in the Arabian Sea and called *cærulea*.

Order **CHILOPHIURIDA.**

Family **OPHIOCHITONIDÆ.**

*OPHIOCHITON MEGALASPIS** sp. nov. (Text-fig. 41.)

LOCALITIES:

? Station 45; South Arabian coast; 38 metres. One specimen.

Station 54; South Arabian coast; 1046 metres. One specimen.

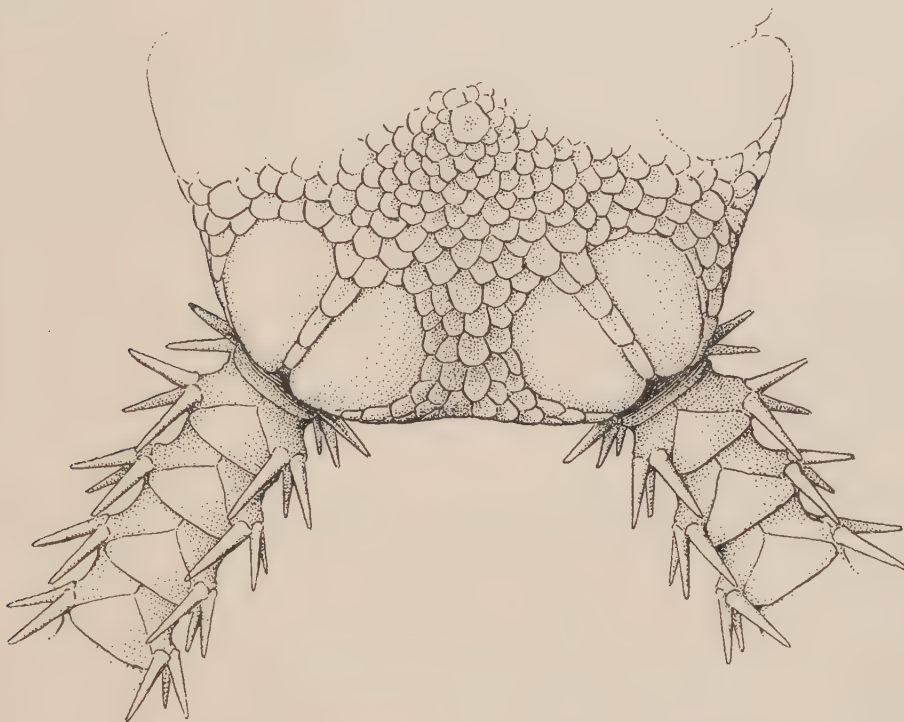
DESCRIPTION.—Disk very flat and thin, rounded pentagonal, 7 mm. in diameter. Arms 5, 30–35 mm. long, rather stout at base, but tapering rapidly to the somewhat attenuate tip. Disk covered with a coat of rather large, flat, more or less circular, but to some extent overlapping scales, and 5 pairs of very large radial shields; in the radial line a single series of elongated scales separates the two shields of a pair, but in each interradius there are about 5 columns of disk-scales overlapping laterally and not elongated. Each radial shield is irregularly pear-shaped, the narrow end distal and distinctly thickened; the shield is about 1.5 mm. long and the width is very nearly the same; the proximal end is somewhat truncate or slightly rounded. Upper arm-plates triangular, much wider than long, slightly swollen, with lateral angles rounded, well separated from each other.

Interbrachial areas below well covered with scales similar to those on the disk. Under arm-plates flat, triangular, at first wider than long, but distally length and breadth are about equal; they are well separated from each other except at the very base of the arm. On some of the proximal plates, the tentacle-pores cut into the lateral margins enough to

* $\mu\acute{\epsilon}\gamma\alpha\varsigma(\mu\epsilon\gamma\alpha\lambda)$ = big + $\acute{\alpha}\sigma\pi\acute{\iota}\varsigma$ = shield, in reference to the very large radial shields.

give the plate a pseudo-pentagonal form. Side arm-plates low but thick; each carries 3 arm-spines rather thick at base and bluntly pointed; uppermost longest, exceeding the arm-segment; lowest shortest, about equalling the segment. Tentacle-scales 2, flat and more or less elliptical, about half as long as the under arm-plate; the outer is wider than the inner and more or less overlaps it.

Oral shields rather small, diamond-shape, much wider than long, all angles slightly rounded and each side a trifle concave; distal angle wider, more rounded and more projecting than proximal. Adoral plates relatively large, meeting within, narrower there than at outer end, where a lobe separates the oral shield from the side arm-plate. Oral plates large, carrying 4 oral papillæ, which are flat, rounded or bluntly pointed and subequal, or the distalmost is largest. Teeth rather narrow, bluntly pointed or rounded.



TEXT-FIG. 41.—*Ophiochiton megalaspis* sp. nov. Dorsal view of part of disk and two arm-bases. $\times 12$.

Colour (dry) dull, pale greenish grey, becoming nearly white on the distal part of the arms; each disk scale has the margin a little lighter than the centre.

REMARKS.—The holotype is from Station 54. The paratype, which is very similar but smaller, is supposed to be from Station 45. It is rather more than 5 mm. across the disk and the arms are 25 mm. long. It is lighter coloured than the larger specimen, and the disk-scales are not distinctly lighter on the margin. As the genus is normally found in moderately deep water, 125–2150 metres, it seems to me probable that there has been a mistake in transcribing the station number, and that the smaller specimen is really from the same station (54) as the larger. The species is easily distinguished from the other known members of the genus by its very large radial shields, coarse disk-scales and triangular upper and under arm-plates.

OPHIONEREIS AUSTRALIS (H. L. Clark).

Ophiichiton australis H. L. Clark, 1923, p. 345 ; pl. 20, figs. 1, 2.

Ophionereis australis Mortensen, 1933a, p. 374.

LOCALITY.—Station 45 ; South Arabian coast ; 38 metres. Three specimens.

RANGE.—Coast of Natal, 85–200 metres.

NOTES.—These specimens range from 5 to 8 mm. across the disk, and the arms were apparently about 7 times as much. They resemble so closely a paratype from Natal that they call for little discussion. They are lighter coloured and show the markings more clearly ; the lower surface of the arms is white, indefinitely but evidently banded with light reddish purple. The upper surface of the arms is also somewhat banded with a dull purplish dusky, and the white on the radial shields is very conspicuous.

REMARKS.—As Dr. Mortensen (1933a) has pointed out, in my original description of this species I completely overlooked the supplementary plates and yet published a figure showing them ! As Mortensen says, they are developed only on the basal part of the arm in young specimens, and even in adults appear to die out distally. They seem to be more generally present and more easily seen in the Arabian specimens than in those from South Africa. The finding of *australis* on the South Arabian coast in shallow water is indeed a notable extension of its range. Apparently its distribution is like that of *Macrophiothrix brevipeda*.

OPHIONEREIS PORRECTA Lyman.

Ophionereis porrecta Lyman, 1860, p. 260 ; 1865, p. 147, figs. 14 and 15.

LOCALITY.—Station 164 ; Maldive area ; 183 metres. One specimen.

RANGE.—Hawaiian Islands to Japan, Northern Australia, Ceylon and the Laccadive Islands, low water to 100 metres.

NOTES.—The present specimen is 10 mm. across the disk and the arms, all but one of which are detached, are about 75 mm. long. The colour is light and dark grey with touches of cream colour.

REMARKS.—It is not strange that this *Ophionereis* was taken in the Maldive area, for that is not quite so far to the north-west as the station in the Laccadives where the “ Investigator ” took it. But it is noteworthy that its bathymetrical range is considerably extended by the “ Mabahiss ” collection.

Family OPHIOCOMIDÆ.

OPHIOCOMA INSULARIA var. VARIEGATA (E. A. Smith).

Ophiocoma variegata E. A. Smith, 1876, p. 39.

Ophiocoma insularia var. *variegata* H. L. Clark, 1938, p. 330.

LOCALITY.—Station 111 ; Zanzibar area ; 73–165 metres. One specimen.

RANGE.—Widely distributed in the Indo-Pacific region from Zanzibar to the Hawaiian Islands, along shore and in shallow water.

NOTES.—This is a very young individual, only 3.5 mm. across the disk, which is pale grey-brown with a few small touches of cream colour, in contrast to the darker purplish grey of the arms ; the oral frame and basal under arm-plates are very pale cream colour.

REMARKS.—This little individual is too young to throw any light on the relationship of *variegata* to *insularia*, a matter which still needs clearing up.

OPHIOCOMA SCOLOPENDRINA (Lamarck).

Ophiura scolopendrina Lamarck, 1816, p. 544.

Ophiocoma scolopendrina Müller and Troschel, 1842, p. 101. H. L. Clark, 1915; pl. 14, figs. 10 and 11.

LOCALITIES :

Red Sea; Zukayer Island, shore collecting. One specimen.

Locality unknown. Nine specimens.

Station 164; Maldive area; 183 metres. One specimen.

RANGE.—From Arabian Gulf to Mozambique and eastward to the Hawaiian and Paumotu Islands, in shallow water.

NOTES.—The specimen from the Red Sea is a fine adult, and it is the only one whose identity is certain. It is 23 mm. across the disk and the arms are nearly 140 mm. long. The upper surface is uniformly black (really, deep purplish brown) except that the terminal part of each arm is indistinctly banded. Orally there is much white on the oral papillæ, madreporite, under arm-plates, spines and tentacle-scales within the disk; otherwise the lower surface is uniformly dark.

The young specimen from Station 164 is hopelessly immature, and its identification is open to question. So, too, with the nine from an unknown locality, young ones (3–12 mm. across the disk) in very poor condition. The colour is conspicuously light (cream colour through red-brown and grey-brown to dusky brown), probably the result of artificial bleaching. One cannot be sure of the identification, but there is no other known species to which they may be referred.

REMARKS.—It is a little remarkable that more adult *Ophiocomas* were not secured, but the explanation is probably found in the very small amount of really littoral collecting that was done.

Family OPHIODERMATIDÆ.

OPHIURODON CUPIDUM (Koehler).

Ophioconis cupida Koehler, 1905, p. 15; pl. 1, figs. 19 and 20.

Ophiurodon cupida Matsumoto, 1917, p. 315.

Ophiurodon cupidum Koehler, 1930, p. 278.

LOCALITIES :

Station 45; South Arabian coast; 38 metres. One specimen.

Station MB Ib; Red Sea; 29 metres. One specimen.

Station MB Id; Red Sea; 26 metres. One specimen.

RANGE.—Philippines to Kei Islands, 13–60 metres.

NOTES.—The Red Sea specimens, which measure about 5 mm. across the disk and have arms 15–20 mm. long, are in very good condition, but the one from Station 45 has received rough treatment and is badly damaged. It is, however, undoubtedly conspecific with the other two. In all of the specimens the disk is noticeably flat, thin and circular; pale brown where covered with the minute granules, but white where these are rubbed off. The arms are distinctly banded with dusky, the bands being separated by two, three or four light-coloured segments. The very slender arm-spines are white.

REMARKS.—Koehler (1922, pp. 13–16) has given a very useful discussion of the old genus *Ophioconis* and the genera into which Matsumoto (1917, pp. 310–317) broke it. It is now clear that *Ophiurodon* and *Ophiuroconis*, at least, must be placed in the *Ophiodermatidæ*.

BATHYPECTINURA CONSPICUA (Koehler).

Pectinura conspicua Koehler, 1897, p. 322; 1904, pl. 1.

Bathypectinura conspicua H. L. Clark, 1909, p. 130.

LOCALITIES :

Station 26; Gulf of Aden; 2312 metres. Seventeen specimens.

Station 34; Gulf of Aden; 1022 metres. One specimen.

Station 115; Zanzibar area; 640–658 metres. Twenty-seven specimens.

Station 122; Zanzibar area; 732 metres. One specimen.

RANGE.—East Indies and Bay of Bengal, 239–1992 metres.

NOTES.—This is a very striking ophiuran and it is represented in the “Mabahiss” collection by a splendid series of 46 specimens. The smallest are only about 20 mm. in disk diameter, but the largest measure 52 or 53 mm. across, larger than any hitherto recorded. The arms in life were apparently about 6 times the disk diameter. In alcohol or dry these specimens range from pale tawny yellow to nearly white in colour, but in life, according to a field note, they were “apricot orange, slightly paler on centre of disk”.

REMARKS.—When the genus was established (H. L. Clark, 1909), 7 species were assigned to it, of which 3 had been described by Lyman and 4 by Koehler. An eighth species was added by Matsumoto in 1917. But in 1922, Koehler, faced with 24 specimens from 17 “Albatross” stations in the Philippines and East Indies, concluded that there were but 3 valid species, *heros*, *lacertosa* and *reducta*, but not having sufficient material of Lyman’s species for comparison, he continued to use the name *conspicua* for the big East Indian species collected by the “Albatross”. There is no doubt that this is the species taken by the “Mabahiss” and Koehler’s name is used here, as I have no material of *heros* for comparison and only single specimens of *lacertosa* and *tessellata*—Lyman’s West Indian species. Koehler is very sure that Matsumoto’s Japanese species *gotoi* is identical with *conspicua*, but the original description and figures incline me to think Matsumoto may have been right in considering it distinct.

Family OPHIOLEPIDIDÆ.

OPHIOTYPA SIMPLEX Koehler.

Ophiotypa simplex Koehler, 1897, p. 281; pl. 5, figs. 1–3.

LOCALITIES :

Station 120; Zanzibar area; 2926 metres. Nine specimens.

Station 171; central part of Arabian Sea; 3840–3872 metres. Fourteen specimens.

RANGE.—Bay of Bengal, in very deep water (3595 metres).

NOTES.—These interesting specimens are in perfect condition except for the loss of an arm-tip or two in most of them. They range in disk diameter from 3 to 6 mm. and in arm-length from 4 to 7 mm. The largest specimen has the arms 6 mm. long, almost

exactly equalling the disk, while the specimen with the longest arms has the disk scarcely 4 mm. across. In the smallest specimen the arms are 4.5 mm. long. In their present condition the specimens are white, but the huge primary plates have a slight greyish tint, lacking on the arms and small disk-plates. There is no note as to the colour in life. One of the specimens from Station 171 has an interradius almost wholly wanting dorsally, so that two of the arms are closely side by side at disk margin. Orally the jaw in that interradius is minute and imperfectly developed.

REMARKS.—The rediscovery by the “Mabahiss” of this remarkable deep-sea ophiuran, hitherto known only from the two specimens taken by the “Investigator”, is one of the most interesting of her zoological “finds”. Several of the present specimens are notably larger than the types and their arms are apparently better preserved. The depth at which they were taken at Station 171 is even greater than that of the “Investigator” station.

OPHIOPYRGUS ALCOCKI Koehler.

Ophiopyrgus alcocki Koehler, 1897, p. 283; pl. 5, figs. 4–6.

LOCALITIES :

Station 119; Zanzibar area; 1207–1463 metres. Fifteen specimens.

Station 171; central part of Arabian Sea; 3840–3872 metres. Three specimens.

RANGE.—Bay of Bengal, in very deep water (2358 metres).

NOTES.—These specimens, which range from 3 to 6 mm. in disk diameter are in excellent condition, except that the tips of the rather abruptly attenuate arms are always broken. In several cases, however, enough of the tip is present to show that the arms are fully twice the disk diameter and perhaps are a little longer than that. The colour is quite uniformly white.

REMARKS.—This is another of the remarkable ophiurans discovered by the “Investigator” (though she took but a single specimen) and now rediscovered by the “Mabahiss”. The largest of the present series is not quite so large as the unique holotype. Neither in his original figures, nor in those published later in the final “Investigator” report (1899), does Koehler attempt to show the roughly granular surface of the large plates, though he refers to it in the description. Under a magnification of 90 diameters these granules are seen to have glassy tips; on the large disk-plates they are bluntly pointed and scarcely to be called granules, but on the arms (basally only are they present) and orally they are more rounded and granular. The essential features of this striking genus will be found more fully discussed on p. 101.

OPHIOMASTUS TUMIDUS Koehler.

Ophiomastus tumidus Koehler, 1897, p. 285; pl. 5, figs. 7–9.

LOCALITIES :

Station 119; Zanzibar area; 1207–1463 metres. Seven specimens.

Station ? One specimen.

RANGE.—Bay of Bengal, in very deep water (2358 metres); also in the East Indies at lesser depths (301–1158 metres).

NOTES.—These specimens range from less than 3 to about 3.5 mm. in diameter, confirming Koehler’s view based on both the “Investigator” and “Siboga” collections

that specimens 4 mm. across the disk are adults. The present series is in excellent condition, but calls for no special comment. It is probable that the one from an unknown station was taken at Station 119.

REMARKS.—Again we have here an “Investigator” discovery confirmed by the “Mabahiss”, and it is interesting to note that the “Mabahiss” specimens were taken in company with *Ophiopyrgus alcocki* just as were those of the “Investigator”. It is curious that the “Siboga” met with *tumidus* in very much shallower water than it inhabits in the Bay of Bengal or off Zanzibar.

OPHIOMASTUS PLATYDISCUS* sp. nov. (Text-fig. 42.)

LOCALITY.—Station 120 ; Zanzibar area ; 2926 metres. One specimen.

DESCRIPTION.—Disk low rounded conical, 4 mm. in diameter and almost 2 mm. high. Arms 5, short, terete and rigid, about 8 mm. long when complete, but all are broken ; one, however, is very nearly perfect. Disk covered by a huge central plate more than 1.5 mm. in diameter, 5 large radials, 5 pairs of rather small radial shields, and 3 plates in a linear series in each interradius, of which the marginal is largest and the most proximal is smallest. Radial shields heptagonal, widest proximally, the longest side, adjoining the interradiial marginal plate, may be quite concave ; the shields are in contact along their inner margins. Distally between them is a somewhat swollen triangular plate, wider than long, which may be a disk-plate, but it seems better to call it the first upper arm-plate. Appressed to its distal margin is the pentagonal second upper arm-plate, also wider than long ; the succeeding plates are triangular with a convex distal margin ; they decrease steadily in size distally, and the distance between them increases correspondingly. All disk and side and lower arm-plates are conspicuously shagreened, the upper arm-plates and oral shields and plates somewhat less so.

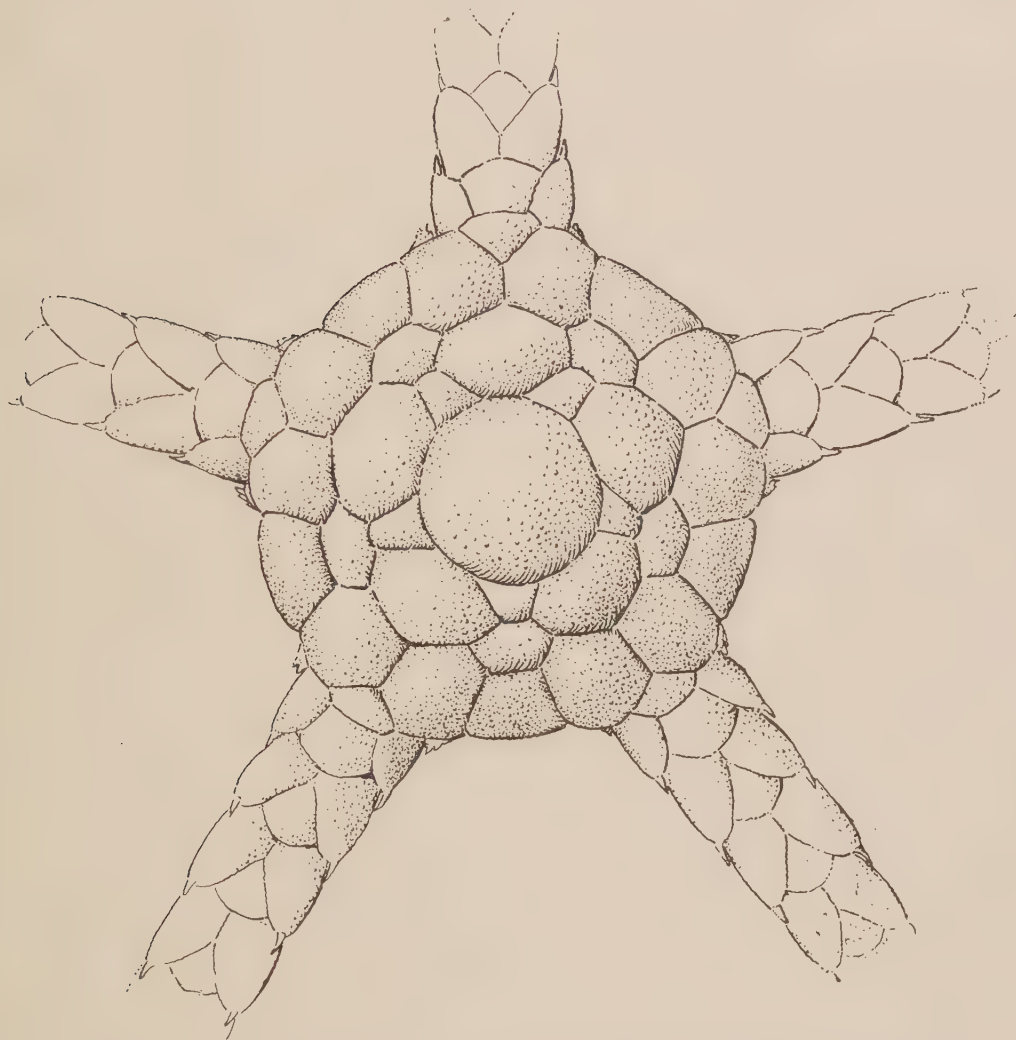
Interbrachial areas below small, covered by a pair of small swollen plates, the small short genital plates and the huge oral shield. Genital slits short, confined to area near arm-base, with notably crenulate margin, due to 6–8 low, rounded papillæ (arm-comb) on the genital scale. Under arm-plates small, much longer than wide, oblong with rounded corners, wider distally than proximally, completely separated, except the first two, which are relatively large and broadly in contact ; the first is somewhat triangular, wider than long, the second is more pentagonal and longer than wide ; distally the under arm-plates become squarish or rounded and very minute. Side arm-plates large, somewhat swollen ; seen from below they are oblique in position ; on the distal margin, each carries 3 minute, slender, well-spaced arm-spines, not one-fifth as long as the plate. Tentacle pores, relatively large, one on each side of each under arm-plate ; on the first (oral) pore there are 3 (rarely 2) scales on the outer side, 2 on the inner ; the next pore shows 2 on the outer side and a rudiment on the inner ; the third pore has a single scale on the outer side ; subsequent pores have no scales.

Oral shields large, pentagonal, somewhat swollen ; inner angle very acute, the others rounded ; length and breadth nearly equal. Adoral plates moderately large, much longer than wide, meeting broadly within in front of the oral shield. Oral papillæ wanting, but the compressed edge of the jaw is slightly scalloped, with 5 or 6 minute crenulations, most distinct near apex of jaw. Colour almost white.

* $\pi\lambda\alpha\tau\acute{\upsilon}\varsigma$ = flat + $\delta\acute{\iota}\sigma\kappa\omicron\varsigma$ = disk, in reference to the form, unusually flattened for this genus.

REMARKS.—Although this specimen is unique, it is probably normal and represents an undescribed species. It is interesting to note that its congener, *tumidus*, was taken at Station 119 in water exactly half as deep.

The genus *Ophiomastus* has never been properly defined, and the line between it and *Ophiopyrgus* has never been clearly drawn. Mr. Lyman based each genus on a single peculiar species, collected by the "Challenger". Of *Ophiomastus* he had three specimens; of *Ophiopyrgus* two (or more?). The general appearance of the two species was so different



TEXT-FIG. 42.—*Ophiomastus platydiscus* sp. nov. Dorsal view of disk and arm-bases. $\times 17$.

that he apparently did not consider them very nearly related, but as the number of species known in each genus has increased the line between them has become difficult to draw. In his diagnosis of *Ophiomastus*, Lyman does not mention a single valid character to separate it from *Ophiomusium*, for oddly enough he does not refer to the tentacle pores, the obvious feature by which the genera are to be distinguished. *Ophiopyrgus* is designated as "the most singular-looking genus yet found among Ophiuridæ", but its "peg-like central primary plate" seems to be the basis of that opinion. However, Lyman refers to its tentacle-pores as "peculiar" and makes them a special feature of his diagnosis. To

appreciate the two genera and appraise them properly, we must go back to Lyman's two species, and study them anew.

Of *Ophiomastus tegulitius* a type specimen is at hand, and examination need not be very detailed to show that it cannot be placed in any genus known in 1878. Its really distinctive characters are the continuous series of tentacle-pores and scales on the short flattened attenuate arms, the high disk covered by the relatively huge, hemispherical primary plates, the swollen adorals and the apparent lack of oral papillæ. Lyman describes and figures (1882, p. 100 ; pl. 8, fig. 16) 3 very low, wide oral papillæ on each side of the jaw, but in the co-type, a magnification of 90 fails to reveal any sutures along the edge of the jaw. Lyman says the papillæ "are so closely soldered as to form an almost continuous narrow line from side mouth shields to apex". In *Ophiomastus secundus* of the West Indies, the oral papillæ are "represented only by a narrow border along the sides of the mouth frames with one large and much swollen one at apex of jaw", according to Lyman's original description and figures. This describes the condition in *O. tumidus* Koehler and in the present species, *platydiscus*. Matsumoto (1917, p. 234) places *Ophiomastus* in a group of 5 genera in which the "basal lateral arm-plates" are "extraordinarily widened". He apparently had not seen a specimen of the genus, but Lyman's figures give no warrant for such an idea ; the basal arm-plates are relatively big and swollen, but they are not abnormally widened, nor are they, it may be added, in *Ophiotypa*, which Matsumoto places in the same group.

Koehler (1922, pp. 352-355) has discussed the matter of the position of the second pair of oral tentacle-pores in the *Ophiolepididæ*, pointing out the inaccuracy of referring to them as ever really opening into the mouth-slits, and questioning therefore the validity of Matsumoto's division of the family into two sub-families. Certainly in *Ophiomastus*, however, there is no question about their position, for they lie close beside the first under arm-plate well away from the oral slits. Another point to which Koehler refers incidentally (p. 357) is the presence in *Ophiopyrgus* of a "radial comb", implying that "radial papillæ" are wanting in *Ophiomastus*. I do not think this is a feature on which we can lay much weight, for such a comb is well developed in the present species (*platydiscus*), and is very rudimentary in the type-species of *Ophiopyrgus*.

We may then define *Ophiomastus* as follows :

A genus of *Ophiolepididæ* in which the disk is covered more or less completely by the primary plates, radial shields and one or more interradiial plates ; the central plate is disproportionately large, while the radial shields may be so small as to be more or less concealed by the big radials. Adoral plates notably big and swollen. First under arm-plates largest or at least nearly equal to second ; succeeding plates diminishing rapidly in size ; each plate is accompanied nearly or quite to the tip of the arm, by a pair of pores ; the basal pores have tentacle-scales on both the side arm-plate and the under arm-plate, but succeeding pores have only one scale (side arm-plate) or none. Oral papillæ wanting, but the compressed margins of the jaw may be more or less distinctly crenulate.

Genotype : *Ophiomastus tegulitius* Lyman.

Including the species herein described there are now known nine species of the genus ; arranged in the order of their description they are as follows :

O. tegulitius Lyman, 1878.

O. secundus Lyman, 1878.

O. texturatus Lyman, 1883.

O. tumidus Koehler, 1897.

O. ludwigi Koehler, 1900.

O. perplexus Koehler, 1904.

O. planulatus (Koehler), 1922, as an *Ophiopyrgus*.

O. melanieæ Hertz, 1927.

O. platydiscus H. L. Clark, 1939.

Of these *ludwigi* should probably be made the type of a new genus, its disk and upper arm-plates, as well as the proximal tentacle-pores setting it apart from the other members of the genus, but without a specimen at hand for examination it would be unwise for me to propose a generic name. Koehler's *Ophiopyrgus planulatus* is unquestionably an *Ophiomastus* and hence is listed here (see p. 102). The present species *platydiscus* may be readily distinguished from its congeners by the relatively low disk and the arrangement of its plates, the narrow, terete and rigid arms and the crenulate margins to the jaws and to the genital scales.

The genus *Ophiopyrgus* is similar to *Ophiomastus* in several features, and a sharp line between them has never been drawn. Matsumoto apparently never saw either, and Lyman places them so far apart in his classification it may fairly be inferred that he did not consider them very nearly related. Studer (1882, p. 9) hints at a relationship, but does not discuss either the resemblance or differences. Koehler, who has added 5 species to *Ophiopyrgus*, does not seem to have ever attempted a definition, for in my opinion, he has included two, and possibly three genera under the name. It is important, therefore, to define *Ophiopyrgus* clearly as shown by the characters of the genotype, of which a co-type is in the Museum of Comparative Zoölogy collection. The following definition is the result of very critical study of this co-type of *wyville-thomsoni* as well as of the specimens in the "Mabahiss" collection of its nearest congener, *alcocki*. *Ophiopyrgus* is a genus of *Ophiolepididæ* in which the disk is extraordinarily high, so that the radial shields are nearly or quite vertical in position; the great central, more or less conical plate, with 5 large primary radials, covers most of the upper side of the disk, but the primary inter-radials may be plainly visible from above. Arms short, wide at base, but tapering abruptly, the distal segments being very long and slender. Upper arm-plates only 3 or 4 at very base of arm, the first of moderate size relatively, but the others minute. Three basal tentacle-pores relatively large, with 3-6 scales on each (both sides of pore); subsequent pores minute with one scale or none. Adoral plates insignificant. Oral papillæ present.

Genotype: *Ophiopyrgus wyville-thomsoni* Lyman.

There are, in my judgment, but two species in the genus, for Koehler's *alcocki* is the only subsequently described species which seems to me really congeneric with Lyman's. Studer's *saccharatus* and Koehler's *trispinosus* and *depressus* form a distinct group which may be called *OPHIOPYRGOIDES*, and for which I propose *Ophiopyrgus trispinosus* Koehler as genotype. The disk is not exceptionally high, but is covered as in *Ophiomastus* with large primary plates and radial shields. Arms rather short and attenuate, the distal joints not elongate. Upper arm-plates present throughout most, if not all, of the arm-length, of moderate size basally. Basal tentacle-pores large with several scales on each side, but they become smaller distally with fewer scales, and the most distal have but a single scale. Adoral plates of moderate size. Oral papillæ small but evident. Radial comb on genital plates well developed. The species comprised by this genus are known as yet only from the East Indies and Fiji Islands in 1150-2058 metres.

Koehler's *Ophiopyrgus planulatus* from Celebes (1922, p. 355), based on a single specimen less than 5 mm. across the disk, is so obviously an *Ophiomastus* it is hard to see why the describer overlooked the fact. On the other hand, the same author's *O. australis* (1901, p. 24), based on a single specimen scarcely 2 mm. across the disk and obviously very young, taken in the Antarctic Ocean at 600 metres, is of dubious affinity, but is probably an *Ophiopyrgoides*, or represents an as yet unnamed genus.

OPIOCHORUS* gen. nov.

Ophiolepid with a markedly convex disk, covered much as in *Ophiomastus* by the primary plates and radial shields. Upper arm-plates practically wanting, though the first one or two may exist. First under arm-plate large, second smaller, subsequent plates rudimentary or wanting. Oral shields and adoral plates large and somewhat swollen. First tentacle pore (second oral pore) large, with 2 or 3 scales on either side; second pore small, with a rudimentary scale or none; subsequent pores small and naked, placed far out on the side arm-plate at the base of the lowest (or lower) arm-spine. Oral papillæ wanting, the edges of the jaw as in *Ophiomastus*.

Genotype: *Ophiochorus granulatus* sp. nov.

The species upon which this genus is based is apparently a specialized *Ophiomastus*, in which the upper and under arm-plates have virtually disappeared and the tentacle-pores have moved out on to the sides of the arm. It is found in very deep water, like its nearest allies, and will probably be found widely distributed in the Indian and East Indian seas.

OPIOCHORUS GRANULATUS† sp. nov. (Text-figs. 43 and 44.)

LOCALITIES:

Station 120; Zanzibar area; 2926 metres. Twenty-four specimens.

Station 171; central part of Arabian Sea; 3840–3872 metres. Seventy specimens.

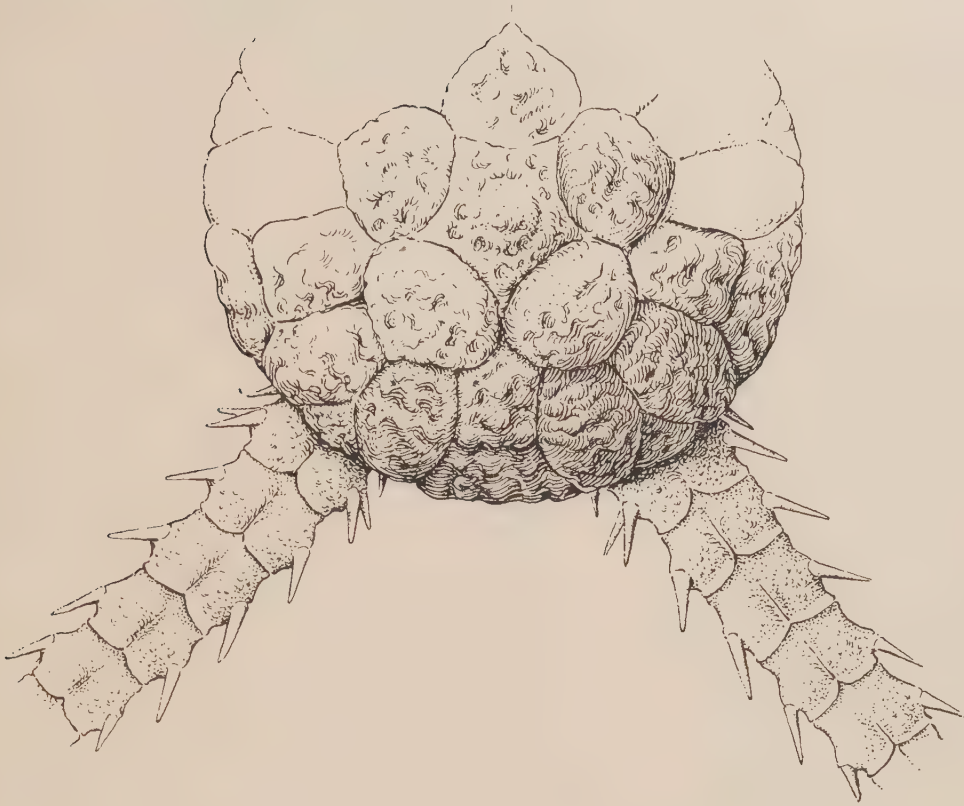
DESCRIPTION.—Disk 4 mm. in diameter, markedly convex. Arms 5, apparently about 10 mm. long, the distal joints long and nearly cylindrical, but not notably so. Disk covered by the primary plates and radial shields, with a second interrational plate of large size forming the margin of the disk; all the plates are convex or somewhat swollen, with rough, sculptured and pitted surface; the lines between them are difficult to detect. Between the distal ends of the radial shields is a triangular plate with a similar surface and hazy boundaries which is apparently the first upper arm-plate, though it is placed on the disk margin rather than on the surface of the arm. No other upper arm-plates can be detected, but the surface is so rough and irregular it is possible that rudiments persist on the basal part of the arm.

Interbrachial areas below covered by the big marginal plate and the oral shield which is rounded pentagonal and a little swollen; its surface is shagreened but not sculptured. No genital slits are visible and the genital scales seem to be rudimentary. First under arm-plate longer than wide, wider distally than proximally; it is not quite so large as an adoral plate; second plate small, more triangular, about as wide as long; subsequent

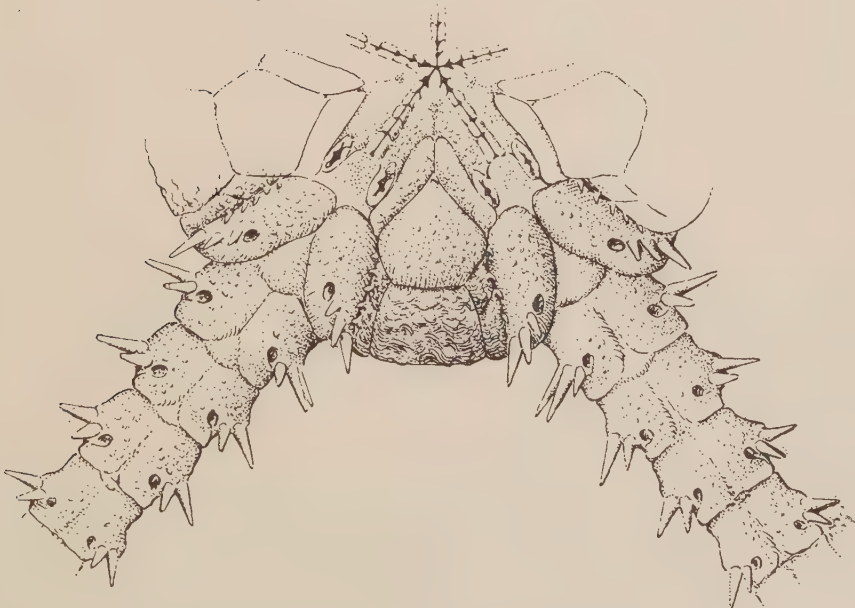
* *Ophio* — + $\chi\omega\rho\omicron\varsigma$ = a space, in reference to the wide space between the two tentacle-pores in each pair.

† *granulatus* = having a granulated surface, in reference to the large granules on the disk-scales.

TEXT-FIG. 43.



TEXT-FIG. 44.



TEXT-FIGS. 43, 44.—*Ophiochorus granulatus* sp. nov. FIG. 43.—Dorsal view of half of disk and two arm-bases. $\times 16$. FIG. 44.—Oral view of same. $\times 16$.

plates wanting as a rule, but the third and rarely the fourth can be detected. Side arm-plates very large relatively, as they make up the whole arm; the first pair are somewhat swollen orally and separate widely the first and second under arm-plates; as these swollen plates are larger than the adorals and have a coarsely pitted surface they give a peculiar appearance to the oral frame. Arm-spines very small and sharp; there are 3 on the basal segments, then 2 and distally they seem to disappear; those at the base of the arm are somewhat bristling, but for the most part they are appressed to the arm-plates. Tentacle pores beside the first under arm-plate relatively big and slit-like, with 2 or 3 rounded scales on either side much as in *Ophiopyrgus*. The pores beside the second under arm-plate are circular and have but a single scale or none; subsequent pores small, circular, with no scale, located at the base of the lowest (or lower) arm-spine; hence they are well out on the side of the arm and the two of a pair are separated from each other by nearly the full width of the arm.

Oral shields relatively large, about as wide as long, rounded pentagonal, with the narrowest angle at the proximal end. Adoral plates small, quadrangular, longer than wide, meeting broadly within, lying as they do against the proximal angle of the oral shield. Oral plates of about the same size and form as the adorals, but somewhat depressed below them. Oral papillæ wanting as in *Ophiomastus*, but the jaw margins are compressed and slightly scalloped, with 3 or 4 low, wide crenulations on each side. Teeth concealed by the pointed termination of the jaw. Colour dingy white.

REMARKS.—The holotype is from Station 171, but the paratypes from Station 120 are so exactly like those from Station 171 that if the two lots were mixed in a single tray the Zanzibar specimens could not be picked out with any certainty. The entire series of specimens range from 3 to 5 mm. in diameter, but the diversity in height is insignificant, as the vertical diameter is about 2 mm. in each one. The central plate, however, shows more diversity, for while it may be only a little convex, especially in large specimens, it is generally a more or less distinctly 5-sided pyramid, especially in the smaller specimens. There is also diversity in the pitting and sculpturing of the plates, which is much more noticeable in some specimens than in others, but there is no evident correlation in this with size. In all specimens the arms are broken, but in several the damage is only at the very tip; they seem to be normally in life a little more than twice the disk diameter.

OPHIURASTER* gen. nov.

Ophiolepid with relatively large flat disk, from which the wide flat arms are not sharply set off. Radial shields very large, occupying the entire disk margin on the aboral surface and appearing orally as pairs of huge interradial plates, against which the tiny oral shields and very large adoral plates abut. Upper and under arm-plates very small, but present nearly or quite to tip of arm.

Genotype: *Ophiuraster perissus* sp. nov.

This little brittle-star could be easily mistaken for a sea-star at first sight, the outline being almost identical with that of some *Goniodiscasters*. Of course, even a hasty examination shows that it is not in any way an asteroid, but simply an ophiuran in which the radial

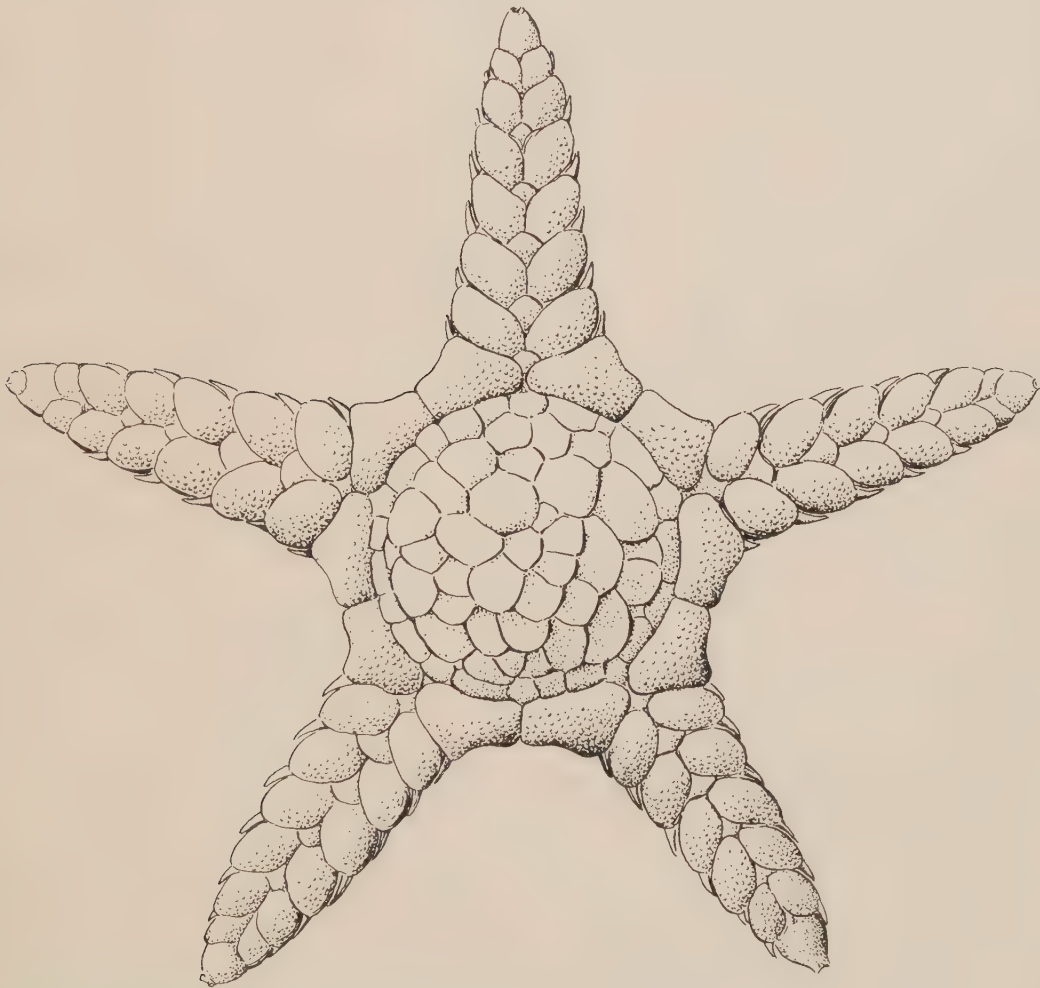
* A combination of *Ophiura* and *Aster* (the root of *Asterias*) in reference to the extraordinarily asteroid appearance of this ophiuran.

plates have become enormously enlarged and the interbrachial areas below completely pre-empted by them. The usual sharp distinction between disk and arms is thus obscured. It is not easy to say with what genera *Ophiuraster* is most nearly allied, but it seems to be a deep-water form, and is probably related as nearly to the three preceding genera, especially *Ophiomastus*, as to any others of the *Ophiolepididæ*.

*OPHIURASTER PERISSUS** sp. nov. (Text-figs. 45 and 46.)

LOCALITY.—Station 26 ; Gulf of Aden ; 2312 metres. One specimen.

DESCRIPTION.—Disk 4 mm. in diameter, very flat, definitely decagonal. Arms 5, very flat, a little more than 3 mm. long, 1.5 mm. wide at base, bluntly pointed. Disk



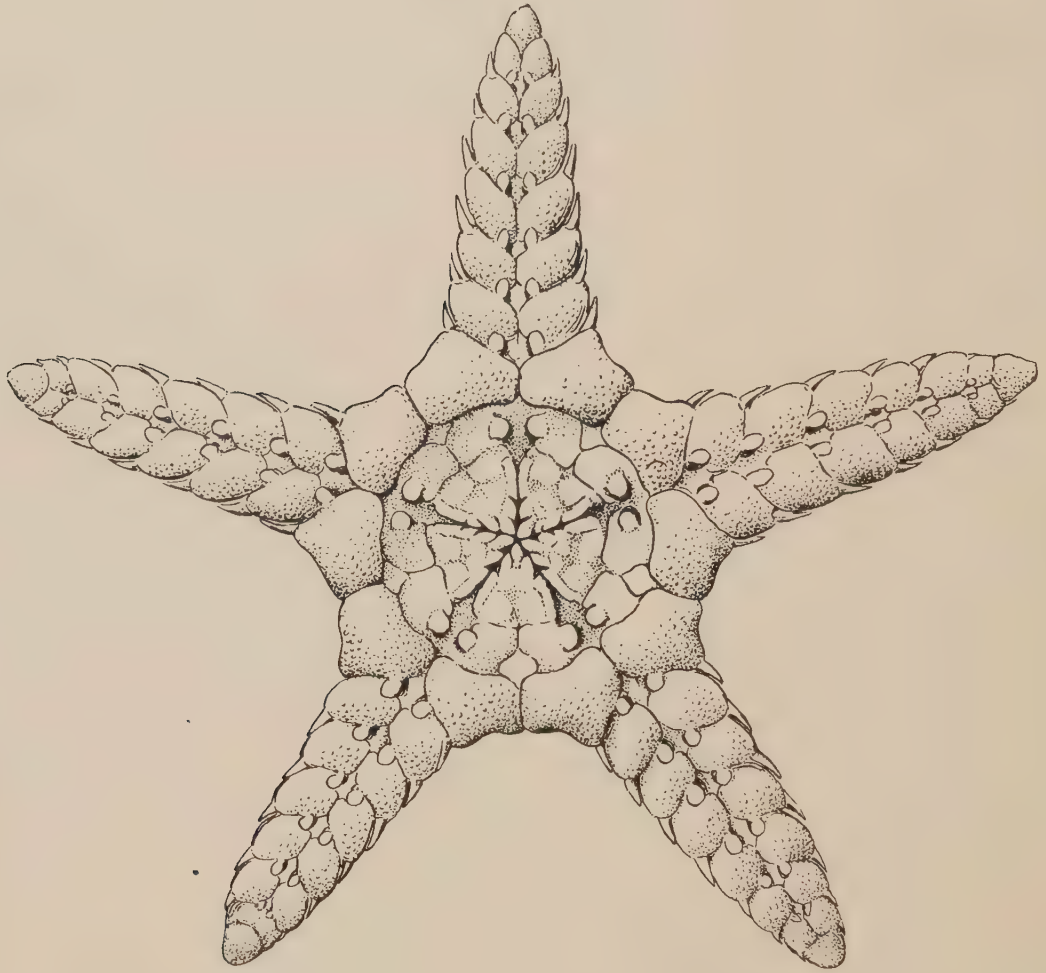
TEXT-FIG. 45.—*Ophiuraster perissus* sp. nov. Dorsal view of entire animal. $\times 14$.

bounded by the 10 huge, radial shields, which enclose a circular area 2.75 mm. in diameter, nearly flat, but a little convex, covered by 40–50 plates or scales, arranged apparently without definite order ; the outermost series is low and wide, and within it are 5 rather large radial plates and 4 about equally large plates at centre of disk ; the remaining plates are small and of irregular distribution. There is no definite central plate. Radial shields

* *περισσός* = extraordinary ; of obvious significance.

thick, slightly swollen, wider than long, with angles rounded; radially the two of a pair are just barely separated, but interradially the plates are broadly in close contact. Upper arm-plates 4-6, minute, diamond-shaped, wider than long, not even nearly in contact; those that should be distalmost appear to be wanting.

Interbrachial areas below wanting, the space being occupied by the extraordinary radial shields which meet not only in the interradiial line, but also radially, separating the



TEXT-FIG. 46.—*Ophiuraster perissus* sp. nov. Oral view of entire animal. $\times 14$.

first and second under arm-plates. These plates are minute and deeply depressed, much longer than wide, with lateral margins concave, due to the large tentacle-pores; the plates are very widely separated from each other, but seem to continue to the tip of the arm. Side arm-plates relatively large and swollen, meeting broadly above and below; each plate carries a single relatively large, thick, opaque, bluntly pointed arm-spine, half as long as the segment; on a few segments a second, similar but somewhat smaller spine occurs. Tentacle-scale single, thick, almost circular, nearly or quite as large as the distal under arm-plates.

Oral shields very small, rounded diamond-shape or roughly triangular, smaller

sometimes than the big tentacle-scale of the second oral pore. Adoral plates large, rhombic, meeting broadly within but separated without by the first under arm-plate. Oral plates very large, but their outlines are hard to make out. Each carries 2 (rarely 3) ill-defined oral papillæ, of which the distal is very low and wide, the proximal (1 or 2) narrow but flat, somewhat erect and bluntly pointed. Apex of jaw occupied by a single large, flat, rounded-triangular papilla; this may be the lowest tooth; it completely conceals any that may be above it. Colour of dry specimen pure white.

REMARKS.—As there is only a single specimen of this remarkable ophiuran, I am not at liberty to dissect it, so that certain details of structure must remain unknown until more material is secured. There is no trace of genital slits, a structural anomaly which it shares with *Ophiomastus* and *Ophiotypa*. The largest specimens of *Ophiopyrgus* show narrow but definite slits alongside the huge oral shields. In a large *Ophiotypa* there is a minute and insignificant pit at each outer corner of the oral shield which might be construed as the last trace (or the first indication) of a genital slit, but I should hesitate to so construe it.

AMPHIOPHIURA CONVEXA (Lyman).

Ophioglypha convexa Lyman, 1878, p. 84; pl. 3, figs. 83, 84.

Amphiophiura convexa Matsumoto, 1915, p. 77.

LOCALITIES :

Station 120; Zanzibar area; 2926 metres. Seven specimens.

Station 171; central part of Arabian Sea; 3840–3872 metres. Ten specimens.

RANGE.—North-western Pacific and tropical Atlantic, in very deep water, 3120–4140 metres.

NOTES.—The specimens from the two widely separated stations show no constant differences and are essentially indistinguishable. They range in disk diameter from 4.5 to 11 mm. and the arms are (or were) not quite 3 times as much. When not missing, the tips of the arms are rolled inward prettily in the horizontal plane.

REMARKS.—This species has been fully and ably discussed by Koehler (1914), and these specimens throw little light on its diversity. The resemblance to *bullata* Wyville Thomson is very marked orally, and in the structure and details of the arms, but the big primary scales of the disk are of a different character and even if somewhat separated by small scales (in very large specimens) they are quite distinctive. The occurrence of *convexa* in the "Mabahiss" collection is very interesting, as it increases the known geographical range enormously. The species has not hitherto been taken in the Indian Ocean or even in the East Indies.

AMPHIOPHIURA PAUPERA (Koehler).

Ophioglypha paupera Koehler, 1897, p. 290; pl. 5, figs. 12, 13.

Amphiophiura paupera Matsumoto, 1915, p. 77.

LOCALITIES :

Station 25; Gulf of Aden; 620 metres. One specimen.

Station 109; Zanzibar area; 640 metres. Seven specimens.

Station 122; Zanzibar area; 732 metres. One specimen.

Station 143; Maldivé area; 797 metres. Thirty-seven specimens.

Station 158; Maldivé area; 786–1170 metres. Six specimens.

RANGE.—China Sea, near southern Luzon to Laccadive Islands in 743–1289 metres.

NOTES.—This is a fine series of specimens, particularly those from the Maldivé Islands. They range in disk diameter from 4.5–9 mm. in diameter, with the arms rather more than twice as much. The arms are apparently flagellate and delicate at tip; in no specimen is there a perfectly complete arm. In colour the specimens range from pure white to pale yellowish; one is dull purplish, but this is obviously artificial.

REMARKS.—Originally taken by the “Investigator” on the Malabar coast and in the Laccadive Islands, the species has been reported subsequently only by Koehler (1922), who discovered a single specimen in the “Albatross” Philippine collection. Its occurrence in the Maldivé Islands would be naturally expected, but the extension of the range by the “Mabahiss” to the Gulf of Aden and to the Zanzibar area is very interesting.

AMPHIOPHIURA SCULPTILIS (Lyman).

Ophioglypha sculptilis Lyman, 1878, p. 84; pl. 4, figs. 115, 116.

Amphiophiura sculptilis Matsumoto, 1915, p. 77.

LOCALITIES.—Station 120; Zanzibar area; 2926 metres. Eight specimens.

RANGE.—North-western Pacific, near Japan, East Indies, Indian Ocean, Antarctic Ocean and Atlantic Ocean, 457–2959 metres.

NOTES.—The specimens from Station 120 are adults, 9–15 mm. across the disk, and there is no question as to their identity.

REMARKS.—The “Valdivia” has already discovered this brittle-star in the Zanzibar region, and Hertz says that young ones (6 mm. in diameter) are much like those of *convexa*, but the number of plates is not so reduced, and the calcareous structure is less coarse.

AMPHIOPHIURA TRIFOLIUM Hertz.

Amphiophiura trifolium Hertz, 1927, p. 78; pl. vi (by error vii), figs. 14, 15.

LOCALITIES:

Station 118; Zanzibar region; 1789 metres. Thirty-five specimens.

Station 135; Maldivé area; 2727 metres. Six specimens.

Station 155; Maldivé area; 2249 metres. Fifteen specimens.

RANGE.—Off British East Africa, 1289–1644 metres.

NOTES.—Although these 56 specimens are more or less damaged (there is not a single entire arm in the possible 280), they make an excellent series of this little known species. The disk diameters range from 4 to 11 mm., with the large adults having a vertical diameter of 3 mm. The disk is thinnest in the small specimens, but the number of plates is considerable and the general appearance is much as in the adults. The specimens are all white, or nearly so.

REMARKS.—The “Valdivia’s” specimens, which were the types of this species, were all young, the largest only 7 mm. across the disk. The adults taken by the “Mabahiss” show considerable resemblance to *sculptilis* in the scaling of the disk, the short, wide radial shields, broadly in contact, and the character of the arm-comb, but the upper arm-plates not including the basal ones are oval or elliptical and not at all diamond-shaped or triangular, and they remain in contact somewhat further out on the arm. Orally the conspicuously trefoil shape of the big oral shields distinguishes the “Valdivia’s” species

at once, while the very narrow adoral plates are a good additional character. The minute peg-like arm-spines are fewer, shorter and less acute than in *sculptilis* and are found almost wholly on the lower half of the side arm-plates. The collecting of this species in the Maldives as well as off Mombasa by the "Mabahiss", indicates that it is widely distributed in the western Indian Ocean in deep water. The bathymetrical range was extended quite as notably by the "Mabahiss" as the geographical.

OPHIURA ÆQUALIS (Lyman).

Ophioglypha æqualis Lyman, 1878, p. 72; pl. 3, figs. 74, 75.

Ophiura æqualis Meissner, 1901, p. 925.

LOCALITY.—Station 119; Zanzibar area; 1207–1463 metres. Two specimens.

RANGE.—Laccadive Islands to the Philippines and south-eastward to New Guinea, 828–2194 metres.

NOTES.—These are young specimens, the smaller 4 mm. in disk diameter, the larger 8 mm. They have been compared with specimens of *æqualis* (including a co-type) in the Museum of Comparative Zoölogy and show no notable peculiarities.

REMARKS.—This species is interesting because of the presence of scattered, minute, slender spinelets on the disk, and especially in the marginal interradial areas. The extension of its range south-westward to Zanzibar is quite natural, but none the less notable.

OPHIURA IRRORATA (Lyman).

Ophioglypha irrorata Lyman, 1878, p. 73; pl. 4, figs. 106–108.

Ophiura irrorata Meissner, 1901, p. 925.

LOCALITIES:

Station 26; Gulf of Aden; 2312 metres. Thirty-five specimens.

Station 59; South Arabian coast; 1948 metres. One specimen.

Station 62; northern area of Arabian Sea; 1893 metres. Seven specimens.

Station 119; Zanzibar area; 1207–1463 metres. Four specimens.

Station 120; Zanzibar area; 2926 metres. Fifteen specimens.

Station 135; Maldivé area; 2727 metres. One specimen.

Station 171; central area of Arabian Sea; 3840–3872 metres. Two specimens.

Station 185; Gulf of Aden; 2000 metres. One specimen.

RANGE.—Almost cosmopolitan in very deep water, 1100–4000 metres.

NOTES.—This series of 66 specimens ranges in disk diameter from 4 to 26 mm. and shows the usual diversity in disk form, ranging from perfectly circular to pentagonal, with concave sides on the one hand, and, on the other, to decagonal with the radial sides concave and the interradial sides strongly convex, but with the extreme margin nearly straight. Most specimens are quite flat, but some of the circular disks are quite convex. There is much diversity in the shape of the oral shields, the adoral plates, the radial shields and the upper and under arm-plates. Nevertheless there is little doubt as to the identity of these specimens.

REMARKS.—Little need be said concerning this much-named species, whose synonymy and distribution have already been discussed by myself (1911) and by Koehler (1914). It may be mentioned, however, that Hertz (1927) places it in a new genus, *Ophiuroglypha*, and consistently misspells the name as "irrotata".

OPHIURA KINBERGI Ljungman.

Ophiura kinbergi Ljungman, 1866, p. 166. H. L. Clark, 1911, p. 37, fig. 9.

LOCALITIES :

Station 71 ; Gulf of Oman ; 106 metres. One specimen.

Station 80 ; South Arabian coast ; 16–22 metres. One specimen.

Station MB Ib ; Red Sea ; 29 metres. Thirty-six specimens.

Station MB Id ; Red Sea ; 26 metres. Forty-two specimens.

Station MB IIa ; South Arabian coast ; 11 metres. Seven specimens.

Station MB IIc ; South Arabian coast ; 29 metres. Eight specimens.

RANGE.—Hawaii and Japan to South Australia and eastward to Ceylon, the Malabar coast and North-western Australia ; in shallow water, occasionally down to more than 200 metres.

NOTES.—This is an interesting series of specimens ranging from a disk diameter of 2 mm. to adults 10 mm. across. The smallest individual is from Station 71, and is too young to permit positive identification. The finest specimens are the adults from Station MB IIa, which are of maximum size and show well the characteristic disk-scaling, arm-comb, arm-spines and prettily variegated colouring (somewhat faded, naturally). These specimens (and all the others in this collection) have, however, narrow, somewhat swollen upper arm-plates, especially on the middle and distal parts of the arm, giving an appearance to the upper side of the arm quite different from that of Japanese specimens. But similar plates are characteristic of specimens from Broome, West Australia, and occur even in specimens from New South Wales and Hawaii, so they can hardly warrant a varietal name. The Red Sea specimens are all small, the largest scarcely 6 mm. across.

REMARKS.—The discovery of this East Indian species by the “Mabahiss” results in a great extension of its known range, but a very natural one. It may properly be mentioned here that the occurrence of *kinbergi* in the Hawaiian Islands needs verification. The record rests on a specimen in the Museum of Comparative Zoölogy from off Lahaina, Maui, 5–30 fathoms, which was received from a reliable source. There is nevertheless the possibility of an erroneous label or of confusion of specimens from Japan or Australia with what was supposed to be Hawaiian material.

OPHIURA LANCEOLATA* sp. nov. (Text-figs. 47 and 48.)

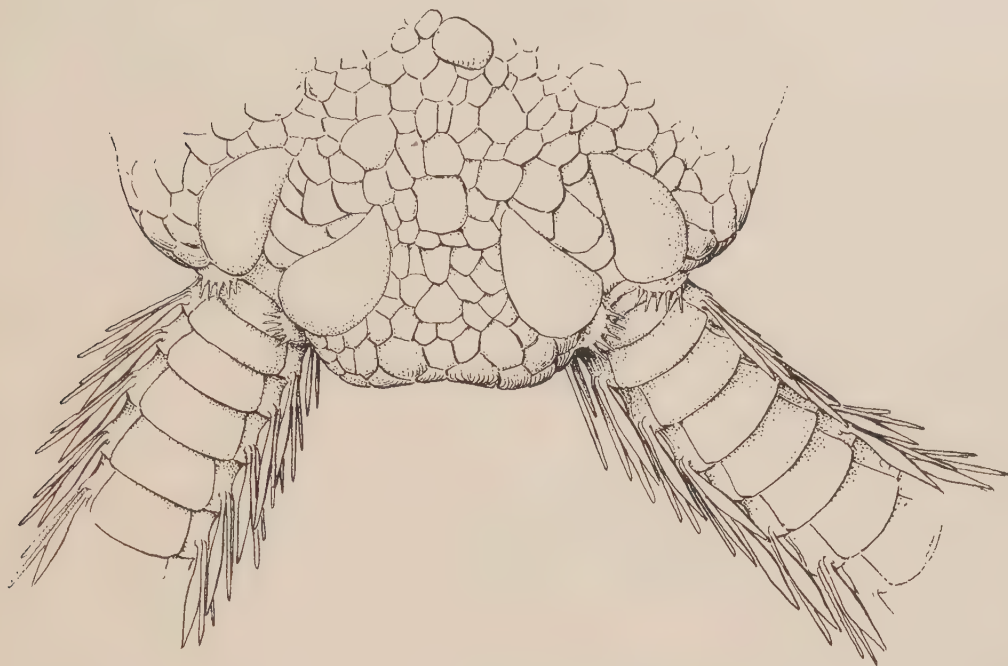
LOCALITY.—Station 153 ; Maldive area ; 256–293 metres. Three specimens.

DESCRIPTION.—Disk 10 mm. across, flat, rounded decagonal, the radial sides concave, the interradial flattened convex. Arms 5 ; all are broken, but they were nearly, and perhaps quite 30 mm. long, rather wide, and somewhat flattened. Disk covered with numerous thin scales of diverse sizes, the larger often more or less surrounded by imperfect belts of smaller ; the primary plates are not easily distinguished ; the largest plates are at the inner end of the radial shields and along the interradial margins. There is a notch in the disk margin at the base of each arm, and the upper ends of the genital scales are noticeable there, each with a conspicuous arm-comb of well-spaced slender, but not very acute spinelets, as long as the second upper arm-plate. Radial shields, about 2 mm. long,

* *lanceolatus* = lance-shaped, in reference to the extraordinary uppermost of the arm-spines.

more than a millimetre wide, pointed within, rounded distally, the outer margin convex, the inner nearly straight; the two of a pair are well separated by a group of relatively large radial plates proximally and the first 2 upper arm-plates distally. These two plates

TEXT-FIG. 47.



TEXT-FIG. 48.



TEXT-FIGS. 47, 48.—*Ophiura lanceolata* sp. nov. FIG. 47.—Dorsal view of nearly half the disk and two arm-bases. $\times 8$. FIG. 48.—Oral view of same. $\times 8$.

are small, the first longer than wide, the second wider than long; the third and fourth plates are twice as wide as long, or even wider; succeeding plates are relatively longer, with the distal and proximal margins nearly equal and the lateral margins straight and almost parallel; beyond the tenth plate the length slowly exceeds the width and the distal

margin becomes convex and more and more exceeds the proximal until at the tip of the arm the plates are longer than wide, triangular, and no longer in contact.

Interbrachial areas below covered by scales similar to those of the disk and the large oral shields; near the latter the scales are small, crowded and overlapping. First under arm-plate small and ill-defined, but wider than long; second even smaller, rounded triangular, much wider than long, well separated from the first by a considerable depression; third plate still smaller, broadly triangular, its width more than twice its length; succeeding plates becoming decreasingly smaller, losing their proximal angle, until they are tiny quadrilateral plates three or four times as wide as long and separated from each other by practically the full length of the arm segment; whether they continue to the tip of the arm cannot be determined from these specimens. Side arm-plates large, forming not only the sides, but also nearly the whole lower surface of the arms. Each carries a series of three fragile spines, each about as long as $1\frac{1}{2}$ arm-segments; the two lower ones are very slender, cylindrical, not very acute, but the uppermost is very flat, widest in the middle, where the width may be as much as one-third the length, narrowed to a slender base and to an acute tip; these extraordinary lanceolate spines lie with their flat surface against the arm. Owing to their fragile structure many spines are missing wholly or in part. Oral tentacle-pores very large, guarded by 4 or 5 scales on each side; first arm-pore somewhat smaller, with 3 or 4 scales on each side; second still smaller, with 3 on each side; third has 2 small scales and one large elliptical scale; all subsequent pores with one large flat, rounded scale more than twice as long as wide, the length equalling half the segment-length.

Oral shields very large, 3 mm. long by 2 mm. wide; they have a wide inner angle with straight sides, slightly concave or notched lateral margins, rounded distal angles and a nearly straight distal margin. Adoral plates long and narrow lying against the inner sides of the oral shield, meeting within and expanding a little distally to separate the shield from the side arm-plates. Oral plates short and swollen, carrying only 3 oral papillæ, a large, unpaired, bluntly-pointed terminal one and a similar but smaller one on each side. In the paratypes there are 2 additional, similar and well-spaced papillæ on each side of each jaw; their absence in the holotype is probably accidental, perhaps due to the rough handling in the dredge. Teeth narrow and bluntly pointed. Colour (dry) disk pale grey with faint indications of brown and dusky markings, somewhat as in *kinbergi*; lower surface and arms nearly white.

REMARKS.—This fine species is nearly related to *kinbergi*, but the remarkable arm-spines and large distal tentacle-scales are very distinctive. The paratypes are but little smaller than the holotype and except for the oral papillæ resemble it closely. All three specimens are considerably damaged by their rough journey in the dredge. It is quite possible that the arm length really exceeds three times the disk diameter, but as that is the proportion in *kinbergi* it is probably similar in this closely related species.

HOMALOPHIURA ABYSSORUM (Lyman).

Ophioglypha abyssorum Lyman, 1883, p. 238; pl. 3, figs. 25–27.

Homalophiura abyssorum H. L. Clark, 1911, p. 326.

Ophiurolepis abyssorum Hertz, 1927, p. 93.

LOCALITY.—Station 135; Maldive area; 2727 metres. One specimen.

RANGE.—Originally taken in the western Atlantic, in 839–1975 metres, it was recorded by Hertz (1927) from the Maldives, in 2253 metres.

NOTES.—The “Mabahiss” specimen is a well-preserved adult, 11 mm. across the disk, with slender arms exceeding 30 mm. Comparison has been made with Lyman’s type material and no adequate reason for regarding it as distinct has been found. There are details in the scaling of the disk which are unlike what is found in the West Indian specimens, but they are too insignificant to discuss.

REMARKS.—Hertz (1927) has already recorded this species from the Maldives, but the confirmation of that unexpected record is very interesting. Why Hertz should have put the species in *Ophiurolepis* is perplexing, for that genus has for its type *Ophiolepis carinata* Studer, which has certain features quite lacking in *abyssorum*. On the other hand, Lyman’s species is clearly a *Homalophiura* and it is probable that the two other species which Hertz calls *Ophiurolepis* are really members of that genus. It is probable that Hertz had not critically examined *Ophiolepis carinifera*.

*HOMALOPHIURA EURYPLAX** sp. nov. (Text-figs. 49 and 50.)

LOCALITY.—Station 184; Gulf of Aden; 1270 metres. Two specimens.

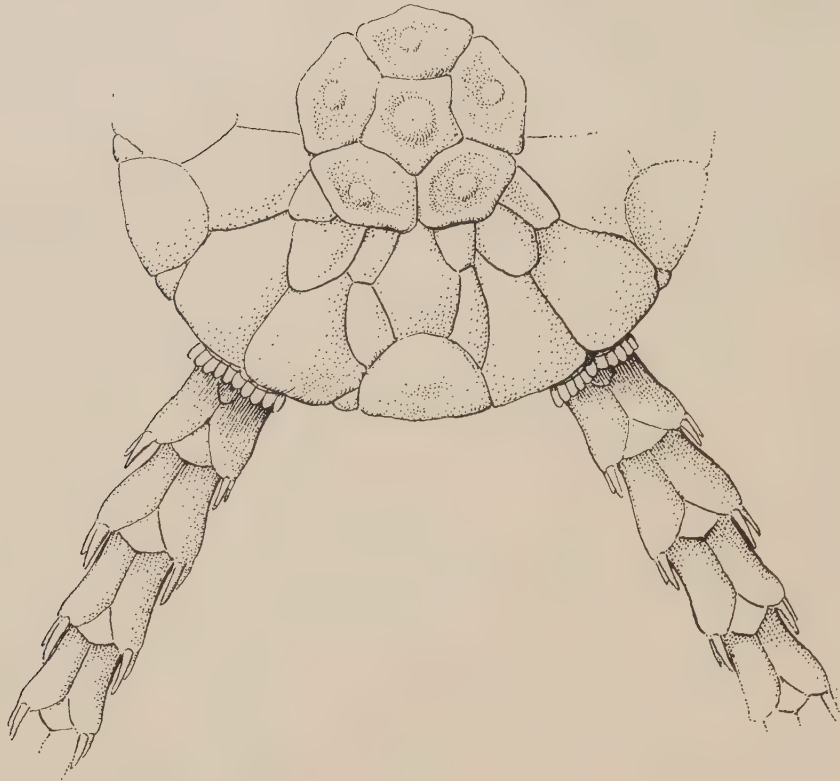
DESCRIPTION.—Disk flat, rounded pentagonal, not quite 6 mm. across. Arms 5, slender, scarcely 16 mm. long, flattened and a little widened at base, the distal end of each segment wider than the proximal. Disk covered by about 40 thin plates and the 10 large radial shields; 6 primary plates form a compact pentagon at centre, 2 mm. across, each plate bearing a single low and inconspicuous central tubercle. Radial shields large, irregularly triangular, longer than wide; along inner margin they seem to overlap for about two-thirds of their length (distally) but the inner ends are separated by a single large diamond-shaped radial plate. In each interradius is a large marginal plate, with or without a small plate on each side. Disk margin overlaps base of arms. Arm-comb conspicuous, of 6–8 close-set, blunt, flat papillæ, which do not extend down on the oral surface of the genital scale. Upper arm-plates minute, triangular, widely separated, decreasing in size from the first, which is largest.

Interbrachial areas below covered by about 10 thin, relatively large scales like those of the disk. Under arm-plates small, much wider than long, and widely separated from each other; the first is somewhat triangular, with the proximal angle truncate; the second is more nearly pentagonal, but the proximal angle is very wide and the width of the plate is more than twice its length; succeeding plates nearly or quite quadrilateral, the width 3 times the length, decreasing in size distally and becoming more and more rounded triangular or elliptical with narrowed ends. The first four plates are separated from each other by shallow but obvious depressions. Side arm-plates very large, making up the bulk of the arm; each plate carries 3 (or 2) slender, bluntly pointed, well-spaced arm-spines, of which the middle or uppermost is longest and may equal (at base of arm) one-half the segment. Oral tentacle-pore relatively large, with 4 flat, rounded scales on each side; first arm-pore with 3 scales on each side, the outer series continuous with the arm-spines; second pore similar but smaller, with only 2 scales on each side; third pore with only 1 scale on each side; fourth scarcely distinguishable, and none thereafter.

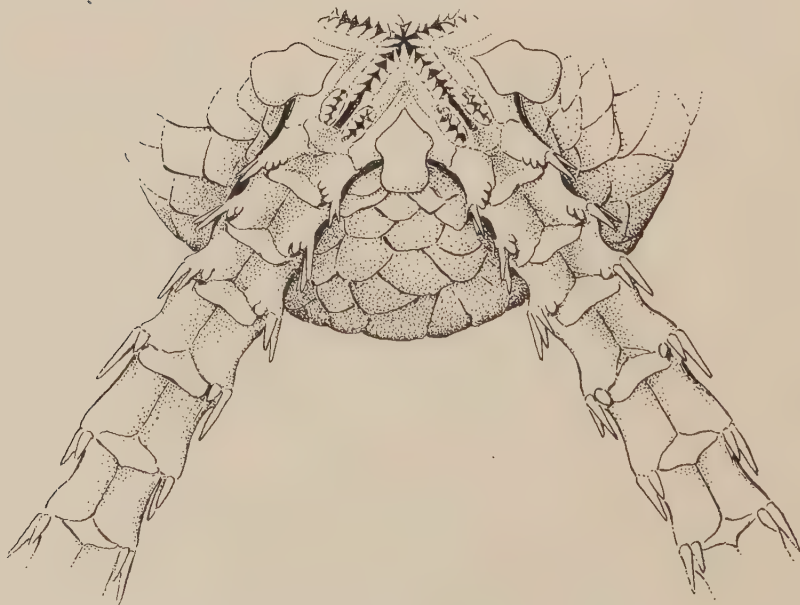
Oral shields very small, more than twice as long as wide, rounded pentagonal, but the

* Εὐρύς = broad + πλάξ = plate, in reference to the extraordinary under arm-plates.

TEXT-FIG. 49.



TEXT-FIG. 50.



TEXT-FIGS. 49, 50.—*Homalophiura euryplax* sp. nov. FIG. 49.—Dorsal view of half the disk and two arm-bases. $\times 16$. FIG. 50.—Oral view of same. $\times 16$.

inner angle may be more or less obscured ; distal end scarcely wider than proximal, lateral margins slightly concave. Adoral plates small and difficult to distinguish. Oral plates apparently larger and somewhat swollen at inner end. Oral papillæ about 6 on each side ; the distal ones are wide, flat, truncate or pointed ; the proximal are bluntly pointed, flat spines ; the unpaired terminal is similar, but is the largest. Colour (of dry specimen) very pale grey, the arms and arm-spines more nearly white.

REMARKS.—The paratype is nearly 8 mm. across the disk and is perfectly tetramerous. It differs very little in details from the smaller specimen. The number of disk-scales is naturally fewer and they are relatively larger ; the central group carry no tubercles. The arm-comb is longer, with 15 or more papillæ. The under arm-plates and oral shields are as in the holotype and give a most striking facies to the oral surface, easily distinguishing this novelty from its congeners.

A note with these specimens says that they were found in a 5-lb. jar of worm-tubes, mingled with shells, crustaceans, sponge spicules and " small cinders " !

*HOMALOPHIURA GLYPTA** sp. nov. (Text-figs. 51 and 52.)

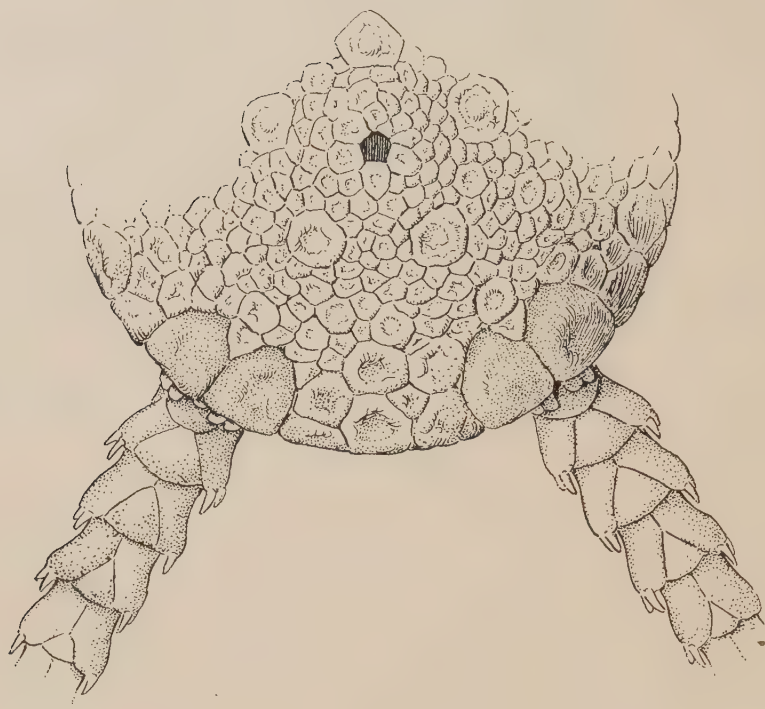
LOCALITY.—Station 135 ; Maldive area ; 2727 metres. One specimen.

DESCRIPTION.—Disk flat, circular, rather more than 5 mm. across. Arms 5, a little flattened, but not much widened at base, tapering rapidly to a very slender tip ; the segments are much wider distally than proximally and become much elongated on the distal portion of the arm. Disk covered with numerous, small, thick, ill-defined porcelain-like plates ; each plate is more or less swollen or is thickened here and depressed there, so that the whole surface of the disk appears to be sculptured in a very irregular but pretty pattern. Even the radial shields, which are small and nearly circular, show indications of this sculpturing ; the two plates of each pair are broadly in contact, but are separated proximally by a small triangular plate. The centre of the disk is depressed, and where the primary central plate should be is an opening, as though the plate had been removed. But the surrounding plates are quite uninjured, and I cannot satisfy myself that this pore is artificial. The primary radial plates can be distinguished without difficulty, but they are some distance from the pore. Arm-comb greatly reduced ; 2-4 low thick papillæ may be detected below each radial shield. Upper arm-plates small, triangular, somewhat swollen ; the first is largest, and the size and swelling decreases steadily on the distal part of the arm, while the distance between the plates increases even more markedly.

Interbrachial areas below covered by plates like those of the disk, but not quite so deeply sculptured. First under arm-plate rather large, pentagonal, its surface a little concave ; well separated from it is the second plate, similar but a little larger, more convex and with its lateral margins slightly indented by the tentacle-pores ; succeeding plates are more and more triangular, but much wider than long, and increasingly widely separated from each other. Side arm-plates large, forming the bulk of the arms. Each plate carried 3 (basally 4) short, thick, peg-like arm-spines placed very close together and appressed to the arm ; distally they are more slender and less appressed. Tentacle-pores reduced—in this specimen tightly closed ; oral pores with 3 low thick scales on each side ; first arm-pore with 2 on each side ; second and third pores with 2 on the side arm-plate ; no pores thereafter.

* *γλυπτός* = sculptured, in reference to the remarkable appearance of the disk.

TEXT-FIG. 51.



TEXT-FIG. 52.



TEXT-FIGS. 51, 52.—*Homalophiura glypta* sp. nov. FIG. 51.—Dorsal view of half of disk and two arm-bases. $\times 16$. FIG. 52.—Oral view of same. $\times 16$.

Oral shields relatively large, wider than long, pentagonal, with a conspicuous inner angle, short lateral margins and a more or less strongly convex distal side. Adoral plates narrow, lying along the sides of the oral plate's angle and meeting fully within. Oral plates shorter and wider, scarcely at all swollen. Oral papillæ so low, thick and close-set that they completely close the oral slits, and it is difficult to make out the number and form; apparently there are 5 or 6 on each side, with the distal ones widest and the unpaired proximal one narrowest. Colour, of dry specimen, pure lustrous white, like porcelain.

REMARKS.—This lovely little ophiuran is so well characterized by its sculptured porcelain-like disk that it will be readily recognized if it is again taken. It is not at all nearly related to "*Ophiura glyptodisca*" (= *Aspidophiura forbesi* Duncan) which I described from Japan in 1911; a shallow-water species in which the so-called sculpturing is of a totally different character. It is quite improbable that the pore in the centre of the disk in the unique holotype of *glypta* is a normal feature, as nothing of the kind is known among ophiurans.

ANOPHIURA* gen. nov.

Ophiolepid with very flat, thin disk bounded by the 10 radial shields and 5 large interradial marginals. Arms slender with very small upper and under arm-plates. Arm-comb wanting. Oral shields, adoral plates and oral plates large, covering a considerable part of the oral surface. Oral papillæ very low and wide, quadrilateral. Only 3 pairs of tentacle-pores on arm, the first with two low wide scales on each side, the other two each with a single circular scale.

Genotype: *Anophiura simplex* sp. nov. (*vide infra*).

The two species here segregated in a new genus represent the extreme development of the group called Homalophiura. The complete absence of an arm-comb, the very definite pattern of disk plating and the extreme reduction of tentacle-pores and scales warrant their generic separation. They are small, very flat, rather fragile brittle-stars, taken as yet only along the southern coast of Arabia in depths exceeding a thousand metres.

ANOPHIURA PLANISSIMA† sp. nov. (Text-figs. 53 and 54).

LOCALITIES:

Station 33; Gulf of Aden; 1295 metres. One specimen.

Station 193; Gulf of Aden; 1061–1080 metres. One specimen.

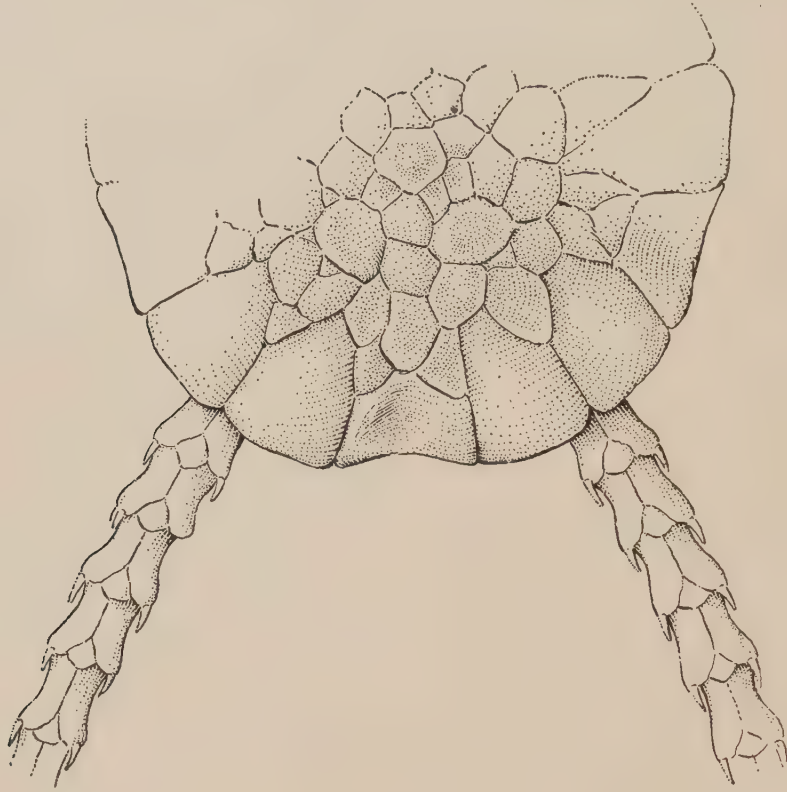
DESCRIPTION.—Disk very flat, thin and smooth, nearly circular, 6 mm. in diameter. Arms 5, all but one are missing; of that one 11 segments, totalling 7 mm. are present; the segments are more or less elongated and are wider distally than proximally; it is evident the arms in life are about 2.5 times the disk diameter, very slender and nearly cylindrical, but a little flattened basally. Disk covered by the 10 big radial shields, and 5 interradial marginals and about 60 other thin, flat scales, among which the primary plates are not conspicuous. All the plates are very smooth and shining like porcelain. Radial shields somewhat triangular, longer than wide, broadly in contact distally, but separated proximally by a large wedge-shaped scale. There is no arm-comb. Upper arm-plates very small and widely separated; first largest, triangular, slightly swollen, longer than

* *av* privative + *ophiura*, in reference to its relation to, but lack of identity with, *Ophiura*.

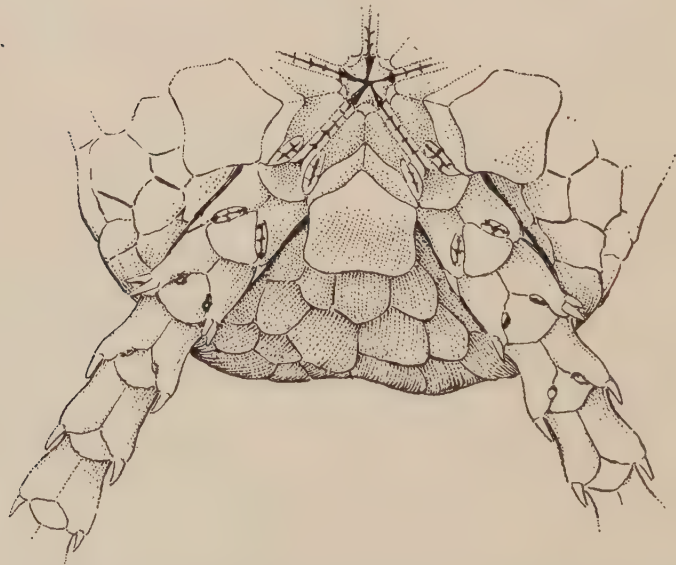
† *planissimus* = most flat, in reference to the extremely depressed form.

wide; second plate similar but shorter; succeeding plates wider than long and very insignificant.

TEXT-FIG. 53.



TEXT-FIG. 54.



TEXT-FIGS. 53, 54.—*Anophiura planissima* sp. nov. FIG. 53.—Dorsal view of half of disk and two arm-bases. $\times 14$. FIG. 54.—Oral view of same. $\times 14$.

Interbrachial areas below covered by the large oral shields and a number of plates like those of the disk. Genital plates relatively large with a smooth margin. Under

arm-plates widely separated; first relatively large, somewhat triangular; second a bit larger and more pentagonal, its lateral margins indented by the tentacle-pore; third plate much wider than long with a convex distal margin and a proximal angle; succeeding plates similar, but smaller and swollen. Side arm-plates very large, forming the bulk of the arm; they are smooth and shining like porcelain. Each one carries 3 minute, acute, appressed arm-spines, scarcely one-third as long as the segment. Tentacle-pores extremely reduced; the oral pore is relatively large, with 3 low, wide, rounded scales more or less soldered together on each side. First arm-pore similar but smaller, with 2 (or 1 only) scales on each side. Second and third-pores minute, protected by a single small circular scale. No subsequent pores.

Oral shields relatively large, pentagonal, wider than long, or length and breadth about equal; there is an acute inner angle, but the other angles are rounded; distal margin straight or slightly concave. Adoral plates large, lying along the inner sides of the oral shield and meeting broadly within; their width is about one-third of the length. Oral plates very large and distinct, bigger than the adorals, curved upward (seen with animal upside down, of course) and slightly swollen at proximal ends. Oral papillæ 3 or 4 on each side, very low and wide, quadrangular, close set, the outermost widest; unpaired terminal papilla flat and triangular.

Colour of dry specimen very pale pearl grey, becoming white orally and on arms, smooth and shining like porcelain.

REMARKS.—The holotype is from Station 193. The paratype is much smaller, only 3 mm. across the disk. All of the arms are present in some degree, and the longer ones indicate that when complete they were four times the disk diameter. There are, of course, fewer plates on the disk, and the 6 central primary plates are conspicuous. The porcelain-like appearance is fully as marked as in the larger specimen. The nearest relative of this interesting brittle-star is no doubt the following species, but probably some of the small species of *Homalophiura* will be found to be more or less closely allied.

*ANOPHIURA SIMPLEX** sp. nov. (Text-figs. 55 and 56.)

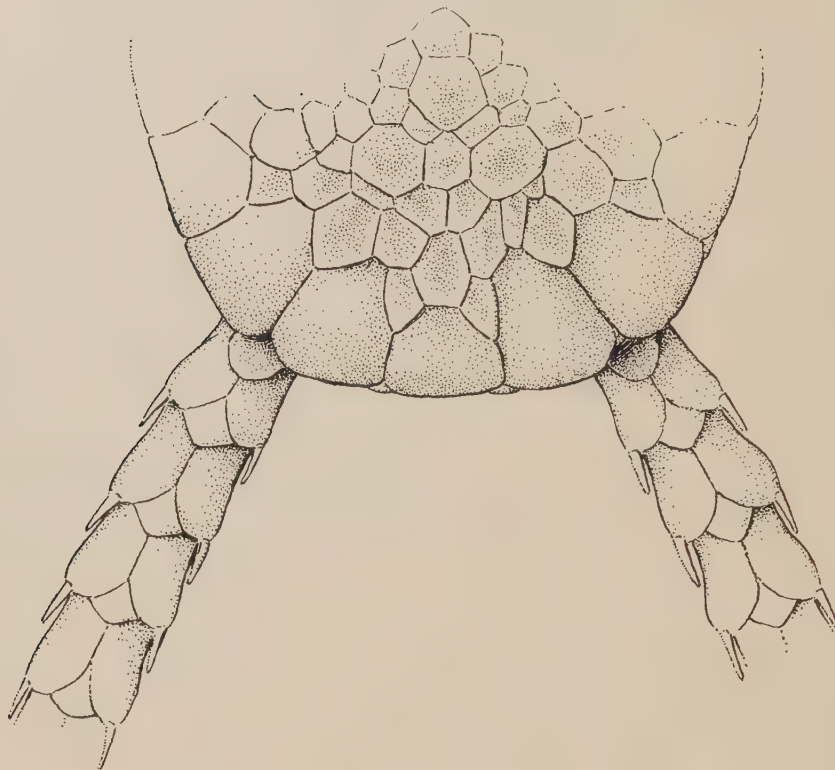
LOCALITY.—Station 54; South Arabian coast; 1046 metres. One specimen.

DESCRIPTION.—Disk very flat and thin, rounded pentagonal, not quite 5 mm. in diameter. Arms 5, all broken, so the approximate length can only be guessed at, but it is obvious that the arms are thicker and the segments shorter than in the preceding species. Disk covered by about 50 plates in addition to the 10 radial shields and the 5 interradial marginals; central primary plate and the 5 radials are quite conspicuous. The plates are all smooth, but very minutely porous, not at all like porcelain. Radial shields about as wide as long, rounded triangular, broadly in contact but separated proximally by an elongated pentagonal scale. The disk slightly overhangs the arm-bases, but there is no trace of an arm-comb. Upper arm-plates very small and widely separated; the basal ones are triangular with a convex distal margin, about as long as wide, but further out they are wider than long.

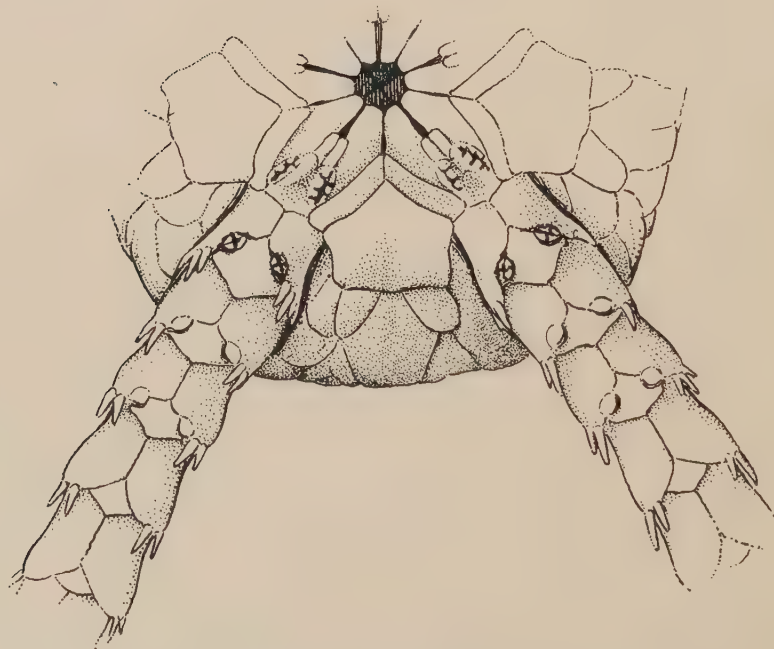
Interbrachial areas below covered by a few plates like those of the disk, and the big oral shield. Under arm-plates widely separated; the first is relatively very large, more or less triangular and longer than wide; the second is similar but more pentagonal, larger,

* *simplex* = simple, in reference to the small number of plates in its make-up.

TEXT-FIG. 55.



TEXT-FIG. 56.



TEXT-FIGS. 55, 56.—*Anophiura simplex* sp. nov. FIG. 55.—Dorsal view of half of disk and two arm-bases. $\times 14$. FIG. 56.—Oral view of same. $\times 14$.

with convex distal margin and concave or slightly notched distal lateral margins; third plate is hexagonal, much wider than long, with deeply notched distal lateral margins; succeeding plates smaller and similar, but beyond the fifth the plates are much smaller and more triangular, always wider than long. Side arm-plates rather short and stout, making up the bulk of the arm; probably distally the segments are more elongated than any now present. Arm-spines 3, minute, the uppermost longest, but not a third of the length of the segment, slender and pointed; they are evidently easily knocked off, for most of the side arm-plates carry only one or two. Tentacle-pores and scales as in the preceding species, only the scales are not at all porcelain-like; oral pore and first arm-pore elongated, with 3 or 2 scales on each side; other pores small, with a single rounded scale.

Oral shields distinctly wider than long, pentagonal, with a rather wide inner angle and a straight distal margin. Adoral and oral plates large and wide, as in the preceding species. Excepting the widest distal ones, the oral papillæ are all wanting, having been knocked off in the rough journey in the dredge, probably; they were, no doubt, like those of *planissima*.

Colour of dry specimen pale grey with a tinge of brown on the outer ends of the radial shields; the upper arm-plates and much of the oral frame more nearly white.

REMARKS.—This species is obviously near the preceding in all details of structure, but the texture of all the plates is so different, they do not look much alike. Moreover, the arm-segments are shorter and thicker in *simplex*, and the first 3 or 4 under arm-plates are markedly different in the two species. It is interesting that their bathymetrical range is the same. Possibly the geographical ranges do not overlap, but that is hardly probable.

OPHIOMUSIUM ALTUM Koehler.

Ophiomusium altum Koehler, 1904, p. 57; pl. 10, figs. 2-4.

LOCALITIES:

Station 26; Gulf of Aden; 2312 metres. One specimen.

Station 118; Zanzibar area; 1789 metres. Three specimens.

RANGE.—East Indies, Strait of Makassar, 1648-2029 metres.

NOTES.—These specimens are a little larger than the two previously known ("Investigator" and "Albatross" collections) having the disk diameter 5-7 mm., but unfortunately they are in poor condition, the outlines of the plates being obscured by a kind of thick membrane, probably an artefact, and the arms are all broken.

REMARKS.—In spite of the difficulty of making out the plates, I have no hesitation in referring these specimens to Koehler's East Indian species. The elevation of the disk in the two larger specimens and the number and character of the arm-spines are good distinguishing features, and so far as the outlines of the plates can be made out, they correspond fairly well to the photographs given by Koehler in 1922 (pl. 80, figs. 6, 7 and 12).

OPHIOMUSIUM CANCELLATUM Lyman.

Ophiomusium cancellatum Lyman, 1878, p. 111; pl. 1, figs. 17 and 18.

LOCALITY.—Station 119; Zanzibar area; 1207-1463 metres. Seventeen specimens.

RANGE.—Eastern Japan, 117-1814 metres. Lyman's record, from Bermuda, is given with a question mark and lacks confirmation.

NOTES.—These specimens, which range in disk diameter from 7 to 14 mm., have been

compared with Japanese material and the differences are so insignificant that their identity seems assured. They are pale greyish white in colour, and the arms are about 3 times the disk diameter.

REMARKS.—It is rather extraordinary to discover this Japanese species off the coast of Zanzibar, since neither the “Investigator” nor “Siboga”, “Valdivia” nor “Albatross”, found it either in Indian waters or in the East Indies.

OPHIOMUSIUM ELEGANS Koehler.

Ophiomusium elegans Koehler, 1897, p. 305 ; 1922, pl. 88, figs. 1–9.

LOCALITIES :

Station 33 ; Gulf of Aden ; 1295 metres. One specimen.

Station 143 ; Maldive area ; 797 metres. Three specimens.

Station 145 ; Maldive area ; 494 metres. Ten specimens.

RANGE.—East Indies to Laccadive Islands, 400–2021 metres.

NOTES.—The specimen from Station 33 is so small, only 4 mm. across the disk, that its identity is open to question, but those from the Maldive area are undoubtedly *elegans*. They range from 9 to 17 mm. in diameter and correspond well with Koehler's (1922) account and figures of the “Albatross” material.

REMARKS.—The discovery of this species in the Maldive area is quite in keeping with its occurrence at the Laccadives. That the range extends to the Gulf of Aden is quite likely, but the specimen from Station 33 is too young to prove it.

OPHIOMUSIUM FAMILIARE Koehler.

Ophiomusium familiare Koehler, 1897, p. 303 ; pl. 6, figs. 20 and 21.

LOCALITIES :

Station 108 ; Zanzibar area ; 786 metres. One specimen.

Station 109 ; Zanzibar area ; 640 metres. Six specimens.

Station 110 ; Zanzibar area ; 347–384 metres. One specimen.

Station 115 ; Zanzibar area ; 640–658 metres. One hundred and thirty-seven specimens.

Station unknown. Two specimens.

RANGE.—Kei Islands, East Indies to the Malabar coast and Maldive Islands, 250–1382 metres.

NOTES.—This is a very fine lot of a little-known species, with disks ranging from 7 to 22 mm. across. The arms are almost always broken near the tip, but are just about three times as long as the disk diameter, in the smallest as well as in the largest specimen. The diversity of colour is rather striking. Several specimens are almost uniformly white, one (from Station 110) is yellowish and several (from Station 115) are dull, dusky purplish grey. The remainder are intermediate between the white and the deep grey ones ; the arms, clear to the mouth may be deep grey, with the disk, including interbranchial areas below, much lighter. Or the disk may be white with the arms gradually becoming grey, or the whole animal may be a light purplish brown. In many cases the tips of the arms, especially if recently regenerated, are white, in marked contrast with the basal portion. Occasionally the transition from white tip to dark proximal segments is not abrupt but very gradual.

It would be interesting to have colour notes on the appearance of these brittle-stars in life. Alcoholic specimens are naturally more brightly coloured, and the contrasts between the light and dark shades are often very handsome. The brown of the arms may be very dark, approaching black in some cases.

REMARKS.—A specimen of *familiare* from the "Investigator" collections, from the Andaman Islands, sent to the Museum of Comparative Zoölogy by the Indian Museum has been compared with this material from Zanzibar and validates the identification. The extension of range geographically is considerable, but there is none bathymetrically.

OPHIOMUSIUM LÜTKENI Lyman.

Ophiomusium lütkeni Lyman, 1878, p. 114; pl. 5, figs. 138–140.

LOCALITIES :

Station 105; Zanzibar area; 238–293 metres. Ten specimens.

Station 106; Zanzibar area; 183–194 metres. One hundred and forty-four specimens.

RANGE.—Japan to the Kei Islands, 196–274 metres.

NOTES.—This is a fine series of a well-marked species, as the specimens range from 4 to 10 mm. in disk diameters. The arms are notably short, for in no case are they equal to twice the width of the disk. They are without exception broken, but usually it is obvious that only the most attenuate terminal joints are missing. The colour is nearly white.

REMARKS.—These specimens have been compared with a co-type of *lütkeni* from the Kei Islands and with specimens from Japan. There is notable agreement in all respects except the length of arms. In Lyman's specimen (which is 14 mm. across) the arms are about 3 times disk diameter and in those from Japan (10–13 mm. across) they are about 2.5 times, but in these Zanzibar specimens they could scarcely have been, even in life, more than twice the width of the disk. If this peculiarity of East African specimens should prove to be constant, a varietal name might be useful.

OPHIOMUSIUM VALIDUM Ljungman.

Ophiomusium validum Ljungman, 1871, p. 618. Lyman, 1882, pl. 1, figs. 1–3.

LOCALITIES :

Station 107; Zanzibar area; 421–457 metres. Two specimens.

Station 115; Zanzibar area; 640–658 metres. One hundred and thirty-two specimens.

RANGE.—West Indies, East Indies, Laccadive Islands, 108–2732 metres.

NOTES.—The two specimens from Station 107 are obviously young, 4.5 and 8 mm. across the disk, but those from Station 115 are fine adults, 11–22 mm. in disk diameter. The largest previously reported were 12–13 mm. across. The smallest specimen at hand has one arm practically complete, and it measures less than 12 mm., or rather less than 3 times the disk diameter. An adult, 17 mm. across the disk has one arm over 60 mm. long, with the terminal segments missing; in this specimen therefore the arms were about 4 times the disk diameter, and this is apparently the usual proportion for the species. In the largest specimen (22 mm.) the arms are all broken, but enough of one is present to warrant an estimate of close to 90 mm. for its length; diameter at base 5 mm., at 45 mm. from base a little more than 2 mm.; the tapering of the arms is therefore quite abrupt.

Compared with large West Indian specimens (not hitherto described or discussed) the scaling of the disk is firmer and smoother in those from Zanzibar, and the arm-spines are smaller and more irregular.

REMARKS.—Koehler (1897) first reported *validum* from the Indian Ocean and a few years later (1905) recorded the "Siboga's" discovery of it in the East Indies. He has discussed some of the diversity shown by his specimens, but he apparently did not note a curious error made by Lyman, who says (1878, p. 114; 1882, p. 92), "No under arm-plates beyond the third". This is true only of young individuals; in the youngest at hand there are no plates visible except the basal three, and in the specimen 8 mm. across on four arms there are no other plates, but on one arm 4 or 5 rudimentary plates can be made out on the proximal segments. In larger specimens under arm-plates can be easily seen on the proximal half of the arm; in the largest specimen at least 25 are present on each arm. It is true they are small, particularly the more distal ones, but they are undoubtedly present. This is as true of West Indian specimens as of those from Zanzibar. As Ljungman says (1871, p. 619) in his original description of the "*scutella brachiorum ventralia*", after discussing the first three, "*longius ab ore rudimentaria*", it is strange that Mr. Lyman should have made this slip.

OPHIOMUSIUM BREVE sp.* nov. (Text-figs. 57 and 58.)

LOCALITY.—Station 105; Zanzibar area; 238–293 metres. Three specimens.

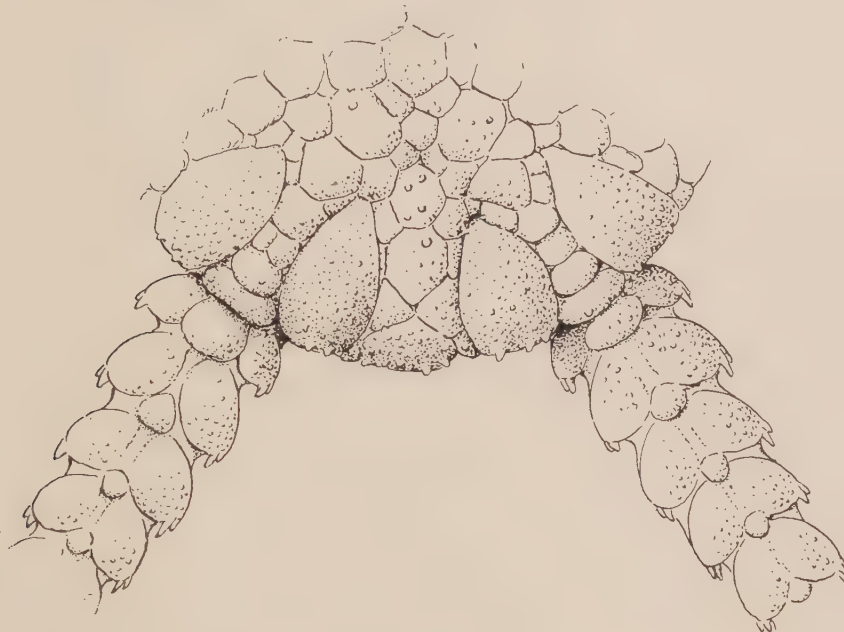
DESCRIPTION.—Disk very slightly elevated but not convex, 6 mm. in diameter. Arms 5, fairly wide at base but tapering rapidly to an attenuate tip, about 12 mm. long, or twice the disk diameter. Disk covered with about 100 scales with a finely shagreened surface; the primary plates and radial shields, with two or three others, arranged in diverging series in each radius and interradius, form most of the covering however. Radial shields triangular (with rounded angles) widely separated both radially and interradi ally, about 1.30 mm. long, with the distal end about 1 mm. wide. Upper arm-plates small but persistent to the middle of the arm; the first is elliptical, twice as wide as long, distinctly swollen and crowded against the similar but larger distalmost radial plate; succeeding plates much smaller, rounded triangular or circular, more or less swollen, or at least convex.

Interbrachial areas below covered by about a dozen scales between the large genital plates; 3 scales are marginal in position and bear on their distal edge 3–5 small, conical granules. These granules are distinctly visible from above and form an irregular but more or less continuous series around the disk, as similar but somewhat smaller ones occur on the arm-bases, at the upper end of the genital plates. Proximal to the 3 marginal scales in each interradius is a large scale with a smaller one on each side; between it and the oral shield is another large scale and several small ones, but their number, size and position are diverse. Genital slits long, with finely notched margins. Under arm-plates present on proximal half of arm; the first 3 are relatively large, more or less pentagonal, but longer than wide, with concave margins, slightly convex with a shagreened surface; succeeding plates rounded triangular, wider than long at first, but becoming rapidly smaller and smaller and more nearly circular, until they disappear. Side arm-plates large and solid as usual in the genus, the distal ends much wider and more swollen than the proximal, the surface strongly shagreened. Each carries 3 (4 or 2) thick but pointed

* *brevis* = short, in reference to the notably short arms.

arm-spines, about one-fourth as long as the plate itself. Tentacle-pores 3 on each side, each one protected by a relatively large, convex scale on the outer side and a similar but smaller one on the inner.

TEXT-FIG. 57.



TEXT-FIG. 58.



TEXT-FIGS. 57, 58.—*Ophiomusium breve* sp. nov. FIG. 57.—Dorsal view of part of disk and two arm-bases. $\times 14$. FIG. 58.—Oral view of same. $\times 14$.

Oral shields small, much longer than wide, sharply pointed within, but with a rounded-truncate distal end. Adoral plates nearly as large, their pointed inner ends meeting at the tip of the oral shield. Jaws short and wide, the 3-5 oral papillæ low and ill-defined, but the outermost is widest. Colour (dry) nearly white, but the radial shields and larger disk-scales are a trifle more greyish.

REMARKS.—Of the two paratypes one is only 3 mm. across the disk, but the other is

as large as the one described. They show no points of difference which call for comment. The species itself seems quite distinct from any previously known, and will be easily recognized by the character of the disk scaling, the fringe of marginal granules, the small oral shields, the swollen side arm-plates, with strongly shagreened or granular surface, and the few, tiny arm-spines.

*OPHIOMUSIUM NITIDUM** sp. nov. (Text-figs. 59 and 60.)

LOCALITY.—Station 171 ; central part of the Arabian Sea ; 3840–3872 metres. Four specimens.

DESCRIPTION.—Disk more or less elevated, almost 7 mm. across. Arms 5, somewhat slender and stiff, rather more than 20 mm. long, though the tips are missing. Disk covered with about 60–65 plates, of which the radial shields are largest, but the 5 primary plates and a large marginal plate in each interradius are very conspicuous. The central plate is notably smaller than the radials. A triangular plate separates the inner ends of the radial shields and another nearly or quite as large separates their distal ends. All of these larger plates (except the radial shields) are markedly convex, and have a shagreen-like surface, as do the radial shields. When viewed without magnification, however, the surface seems more or less glazed and shining. Radial shields irregularly pentagonal, longer than wide, the interradii side slightly concave (because of the large interradii plate) the outer end truncate with rounded corners ; they are in contact at only one point near the middle of the radial side. Upper arm-plates small and widely separated, disappearing distal to the middle of the arm ; the first is somewhat crescentic, with blunt ends, and adjoins the distal radial plate very closely. Succeeding plates more or less triangular, with rounded corners, longer than wide at first, but when very small the length and breadth are about equal.

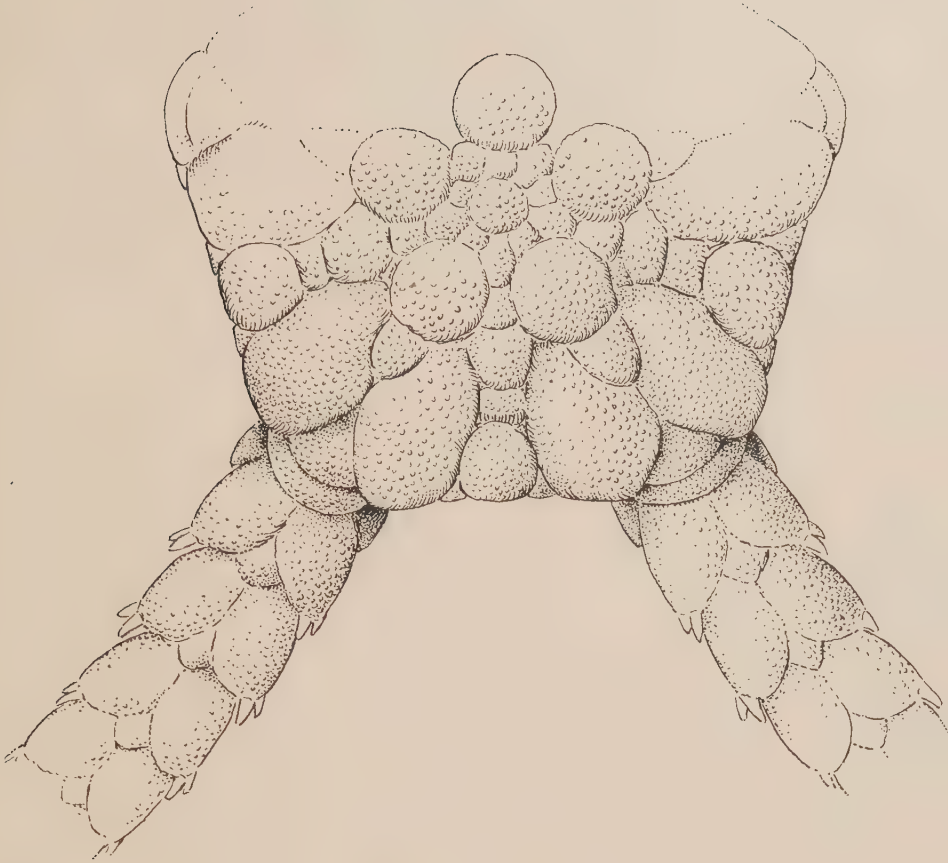
Interbrachial areas below covered by 5–8 small convex plates, but the oral frame is large and the oral shields extend fully halfway to margin. Genital slits seem to be wanting. The whole oral surface is covered by more or less of a membrane, which is probably an artefact, but which conceals to some extent the plate outlines. About a dozen under arm-plates are present, but only the first three are worthy of note ; they are somewhat pentagonal, a little longer than wide, with concave lateral margins, slightly separated from each other ; the remaining plates are minute triangles widely separated and soon disappearing. Side arm-plates large, longer than wide, not swollen ; distal ends project but little, so the arms are flattened cylinders, but regularly notched and tapering. Arm-spines 3, subequal, bluntly pointed, very small, about one-fourth as long as the arm-segment, or less. Tentacle-pores 3 on each side of the arm-base, very small, covered by a single minute tentacle scale on the outer side of the pore ; rudiments of a second scale may be detected on the inner side.

Oral shields longer than wide, pointed within, rounded without, slightly swollen ; adoral plates similar but a trifle larger, even more swollen and conspicuously shagreened. Jaws short and wide. Oral papillæ 5 on each side, low and wide, their outlines indistinct, but the outermost widest. Colour (dry) shining pearly white.

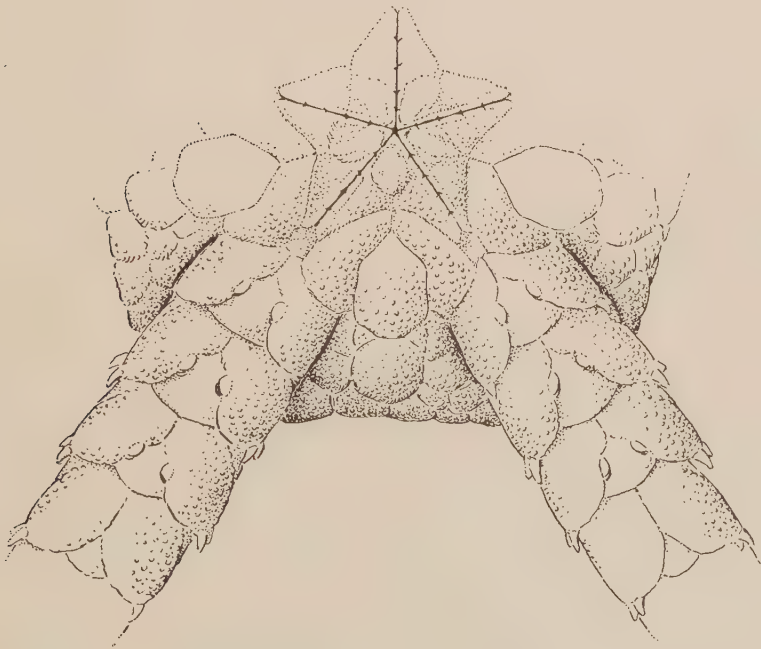
REMARKS.—In most particulars this species is very similar to the West Indian species *serratum*, but when specimens of the same size are placed side by side, they look quite

* *nitidus* = shining, in reference to the glazed, shining appearance.

TEXT-FIG. 59.



TEXT-FIG. 60.



TEXT-FIGS. 59, 60.—*Ophiomusium nitidum* sp. nov. FIG. 59.—Dorsal view of most of disk and two arm-bases. $\times 12$. FIG. 60.—Oral view of same. $\times 12$.

different. The West Indian species is flatter and smoother, the plates are not at all swollen, lack the coarse shagreen surface and the sheen, and the genital slits are very evident. Of course, more abundant material from the Arabian Sea or Indian Ocean may show that these differences are not constant and have no real value, but for the present it seems wiser not to record the West Indian species from the Arabian Sea.

The paratypes of *nitidum* range from 3 to 5 mm. across the disk; the arms are not quite three times as much. The coarsely shagreened surface and the sheen are evident in all, and there is no trace of genital slits. They are apparently not the young of any species as yet described, but it is, of course, quite possible that not even the holotype is adult.

OPHIOMUSA LYMANI (Wyville Thomson).

Ophiomusium lymani Wyville Thomson, 1873, p. 172.

Ophiomusa lymani Hertz, 1927, p. 103.

LOCALITIES :

Station 26; Gulf of Aden; 2312 metres. Eighteen specimens.

Station 62; northern area of Arabian Sea; 1893 metres. Three specimens.

Station 118; Zanzibar area; 1789 metres. Thirty-one specimens.

Station 119; Zanzibar area; 1207–1463 metres. One specimen.

Station 155; Maldive area; 2249 metres. One specimen.

Station 185; Gulf of Aden; 2000 metres. Two hundred and six specimens.

RANGE.—Almost cosmopolitan in deep water, 126–3435 metres.

NOTES.—This is an interesting lot of a common deep-sea ophiuran, some of the individuals being the largest as yet recorded. The series from Station 185 is particularly notable, as the specimens range from less than 3 mm. across the disk to 48 mm. The largest specimens of *lymani* hitherto recorded were only 35 mm. in disk diameter, so these Gulf of Aden specimens are indeed huge.

REMARKS.—The large specimens at hand confirm Koehler's (1922, p. 413) statement that the number of arm-spines in *lymani* increases with age, and big adults have as many as a dozen, and not merely the 6–8 usually given as the species character. Moreover the spines when so numerous form a very irregularly-spaced series, rather widely separated at the upper end and irregularly grouped near the ventral surface of the arm; the lowest are noticeably the longest.

OPHIOMUSA ULTIMA Hertz.

Ophiomusa ultima Hertz, 1927, p. 106; pl. 9, figs. 1–3.

LOCALITY.—Station 105; Zanzibar area; 238–293 metres. Five specimens.

RANGE.—East and north of Zanzibar, 400–638 metres.

NOTES.—These specimens are all small, 2–4 mm. across the disk, but they seem to be quite typical. Not one shows any genital slits, as was the case with the specimens figured in the original description of the species.

REMARKS.—The rediscovery of one of the "Valdivia's" species is interesting but does not extend its range geographically. Bathymetrically the range is brought into somewhat shallower water.

OPHIOZONELLA MOLESTA (Koehler).

Ophiozona molesta Koehler, 1904, p. 22; pl. vi, figs. 3-5.*Ophiozonella molesta* Matsumoto, 1915, p. 82.

LOCALITY.—Station 42; South Arabian coast; 1415 metres. One specimen.

RANGE.—East Indian region from Hong-Kong to the Kei Islands, in 68-1270 metres.

NOTES.—This interesting specimen is 13 mm. across the disk and hence is a little larger than the biggest one hitherto known. The number of disk-scales is much greater than in the holotype, and hence the appearance of this adult is quite different from Koehler's original figures, but fairly like his later photographs (1922, pl. 78, figs. 3 and 4). The colour of the disk is pale grey, but the arms are more nearly white.

REMARKS.—The extension of range made by taking this large adult specimen of *molesta* on the South Arabian coast is indeed notable, since neither the "Investigator" nor the "Valdivia" had secured it in the central and western Indian Ocean. Koehler (1922, p. 428) thinks his species recalls *tessellata* Lyman, but says "the radial shields are smaller and they do not possess the large broadened and short spine on their distal border in *tessellata*". Obviously he means to say the short, thick spine on their distal border as in *tessellata*. This short, thick spine is a conspicuous feature of Lyman's West Indian species, but both Lyman and Koehler err in saying it is borne on the outer end of the radial shield. It is borne either on the upper end of the genital scale or more commonly on a small disk-scale distal to the radial shield. It is not always present, but in almost every specimen is to be found in one or more of the radii. On the whole, it does not seem to me that the resemblance or relationship of *molesta* to *tessellata* is very close.

OPHIOZONELLA BRACHYACTIS* sp. nov. (Text-figs. 61 and 62.)

LOCALITIES:

Station 26; Gulf of Aden; 2312 metres. Two specimens.

Station 185; Gulf of Aden; 2000 metres. Two specimens.

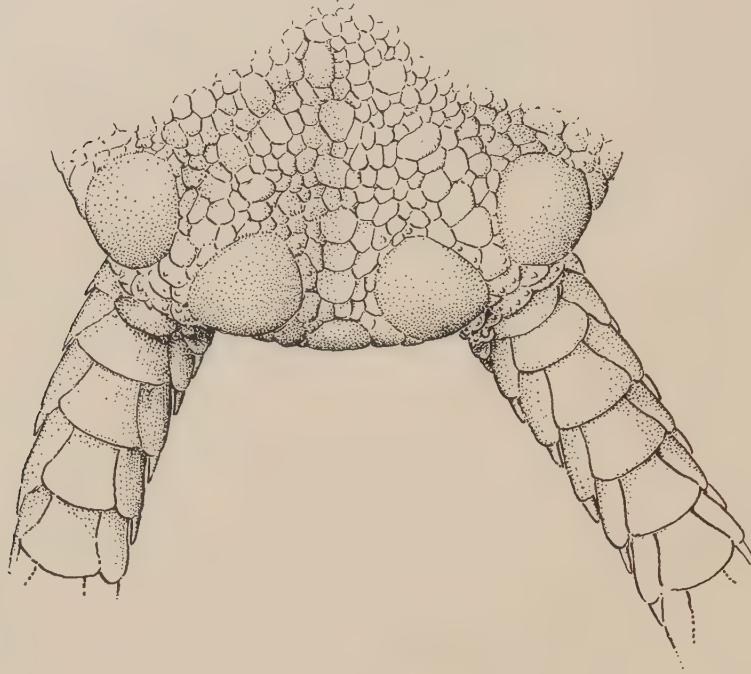
DESCRIPTION.—Disk quite flat, nearly circular, 10 mm. across. Arms 5, stout and nearly cylindrical at base, but tapering rapidly and becoming more flattened distally, not quite 30 mm. long. Disk covered by a close coat of numerous, rather small, slightly swollen scales, among which the primary plates cannot be clearly distinguished, but a large marginal plate occupies most of the interradii edge of the disk between the pairs of radial shields. The latter are about as broad as long, irregularly rounded pentagonal or hexagonal; the two of each pair are widely separated from each other by a group of 6-8 disk-scales of diverse size. Distal to each radial shield are a few minute granules irregularly placed on the disk margin or upper arm-plates; there is no clearly defined boundary between the disk margin and the base of the arm. Radial shields and larger disk-scales not smooth and shining, but very finely shagreened. First upper arm-plate very short and wide, with rounded ends, the width nearly three times the length; second plate more nearly quadrilateral, about twice as wide as long, the distal side a little wider than proximal; third plate with length and breadth more nearly equal and distal margin much longer than proximal; succeeding plates at first similar, but soon becoming longer than

* βραχύς = short + ἄκτις = ray, in reference to the short arms.

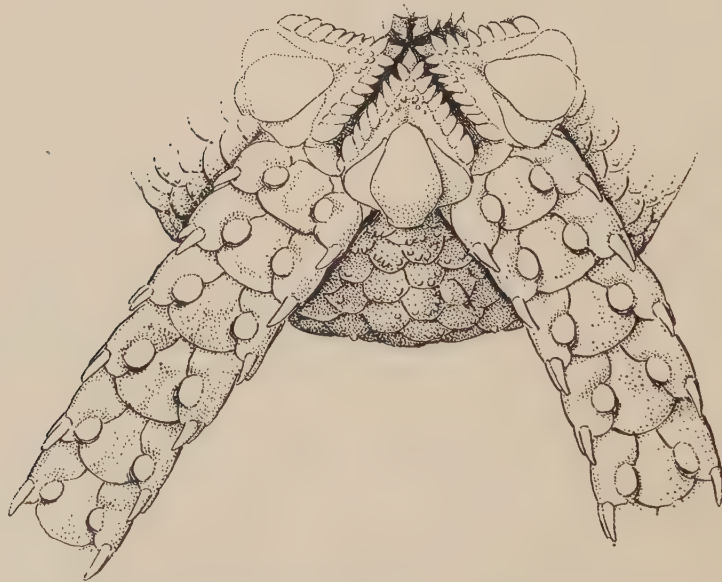
wide and more nearly triangular, until distally, where they cease to be in contact with each other, they are small triangles, increasingly separated by the side arm-plate.

Interbrachial areas below covered with small scales like those of the disk ; on the

TEXT-FIG. 61.



TEXT-FIG. 62.



TEXT-FIGS. 61, 62.—*Ophiozonella brachyactis* sp. nov. FIG. 61.—Dorsal view of part of disk and of two arm-bases. $\times 8$. FIG. 62.—Oral view of same. $\times 8$.

borders of these scales are scattered minute granules similar to those on the radial disk margins. These granules tend to outline the scales, but they are rarely numerous enough to completely encircle even one scale. First under arm-plate of moderate size, triangular, with convex distal margin, a trifle wider than long ; second plate axe-head-shape, the

distal margin convex and wide, the proximal short, straight and fully in contact with first plate, the lateral curved around the tentacle-pores to reach the long distal margin; succeeding plates have the proximal margin shorter and shorter until, beyond the middle of the arm, it is a sharp angle and no longer touches the preceding plate; at the same time the plates, decreasing rapidly in size become more and more nearly triangular, and the big side arm-plates which are wider distally than proximally make up nearly the whole arm. Each plate carries near its lower margin 2 thick, peg-like, bluntly pointed arm-spines which are about one-third as long as the side arm-plates, or a little more. Tentacle-pores rather large basally, continuous to tip of arm, protected by a single large circular tentacle scale, which, near the base of the arm, is fully half a millimetre across.

Oral shields large, pear-shaped, longer than wide, the inner end rounded and distinctly narrower than the outer. Adoral plates small, ill-defined, more or less triangular and lying near widest part of oral shield, separating it from first side-arm plate. Oral plates small, more or less concealed by a number of minute granules, like those on the interbrachial area. Oral papillæ 7 (6-8) on each side, the inner ones small and pointed, the outer ones wider and truncate, the outermost largest, as wide as high or wider, with corners rounded.

Colour of dry specimens very pale grey; the specimens from Station 185 have a definitely yellowish cast, but those from Station 26 show no trace of yellow, and have the arms almost pure white.

REMARKS.—This deep-water *Ophiozonella* from the eastern end of the Gulf of Aden is well set off from the other members of the genus by the large single tentacle-scales, the short, thick arm-spines in pairs, the peculiar shape of the oral shields, and the minute granules on oral plates and interbrachial areas, extending to the dorsal surface of the arm-bases.

The holotype is from Station 185 and the paratype from that station deserves a word. It is apparently tetramerous, but not symmetrically so. The disk is 9 mm. by 8 mm., and the arms are 27 mm. Many arm-segments have 3 arm-spines. There are but 4 jaws, but one of them is badly deformed on one side, and it is possible that the accidental loss of the fifth arm in early youth accounts for this deformity and the present tetramerous condition. The specimens from Station 26 are 7 mm. and 9 mm. across the disk, which is rather convex, but otherwise is not peculiar.

Family OPHIOLEUCIDÆ.

OPHIOCIRCE INUTILIS Koehler.

Ophiocirce inutilis Koehler, 1904, p. 13; pl. 3, figs. 4 and 5.

LOCALITIES:

Station 106; Zanzibar area; 183-194 metres. Fifty-three specimens.

Station 111; Zanzibar area; 73-165 metres. One specimen.

Station 208; Red Sea; 732-805 metres. Two specimens.

RANGE.—Known only from Dutch East Indies, south of Buru, 112 metres, and Philippine Islands between Leyte and Masbate, 209 metres.

NOTES.—The specimen from Station 111 is a particularly fine one, a full 10 mm.

across the disk, and thus much larger than any of Koehler's specimens. The smallest of the present series is 6 mm. in disk diameter, only a little smaller than Koehler's type. The Zanzibar specimens are all nearly pure white, but the two from the Red Sea are a little dingy. In structure, however, they are not distinguishable and one can but wonder as to the possibility of a mistake in the label. Not only is the locality far away from the areas where *Ophiocirce* is known to occur, but the depth is three or four times that at which specimens have otherwise been taken. In any case the discovery of *Ophiocirce* by the "Mabahiss" in the western Indian Ocean is a very notable extension of range.

OPHIOCRATES SECUNDA Koehler.

Ophiocrates secunda Koehler, 1906, p. 14 ; pl. 1, figs. 13 and 14.

LOCALITIES :

Station 34 ; Gulf of Aden ; 1022 metres. One specimen.

Station 158 ; Maldive area ; 786-1170 metres. Two specimens.

RANGE.—West Africa, off Rio de Oro, 2325-2640 metres.

NOTES.—The specimen from the Gulf of Aden is only 5 mm. across the disk, and hence is too small for positive identification, but one of the two from the Maldives is no larger and its identity is determined by the other specimen, which is almost 8 mm. in disk diameter, with arms 24 mm. long. The smaller specimens are like the large one in all essentials, but the granulation of the disk is much more sparse and only surrounds each of the disk-scales and radial shields, leaving all except the very smallest scales quite bare. All of the specimens are white.

REMARKS.—It is hard to believe that a West African species from very deep water should occur in water of less than half the depth in the Maldive Islands, but I cannot find any character whatever by which this brittle-star may be distinguished from Koehler's species. It is worthy of note that in the shape of the radial shields the upper and under arm-plates, tentacle-pores and scales, the oral shields, adoral plates and oral papillæ, there is an extraordinary resemblance between this species and *Ophiozonella brachyactis*. It is hard to believe that they belong in different families.

OPHIOPALLAS PALMARUM Hertz.

Ophiopallas palmarum Hertz, 1927, p. 110 ; pl. 9, figs. 6-9.

LOCALITY.—Station 143 ; Maldive area ; 797 metres. Three specimens.

RANGE.—Off East Africa, 693-1019 metres.

NOTES.—These specimens have the disk 4-5 mm. across. The arms are all broken, but were certainly 6-7 times the disk diameter. The colour is remarkably white, almost chalky.

REMARKS.—It is of obvious interest that this recently described novelty from the "Valdivia" collections should be found by the "Mabahiss" in the Maldives. These

specimens correspond well with the description and excellent photographs given by Hertz, but the peculiarities of the distal arm-spines which are stressed by that author are not very conspicuous.

OPHIOTROCHUS LONGISPINUS H. L. Clark.

Ophiotrochus longispinus H. L. Clark, 1911, p. 94, fig. 33.

LOCALITY.—Station 185 ; Gulf of Aden ; 2000 metres. Five specimens.

RANGE.—Japan, Sagami Sea, 1652 metres.

NOTES.—The only complete specimen is rather more than 6 mm. across the very flat disk. The slender arms are all more or less broken, the longest stump being only 10 mm. long. The very long spines on the second (apparently first) arm-segment are now missing, but their former presence is indicated by the larger bosses. All in all the specimen is much like the original specimen. The other four individuals are smaller and all the arms are broken off close to the disk.

REMARKS.—*Ophiotrochus* is evidently a rare genus of ophiurans, for since the “Challenger” met with it first near New Guinea, it has seldom been taken. The “Siboga” took two specimens in the East Indies and the “Investigator” took two near the Laccadive Islands. These specimens were regarded by Koehler as identical with the “Challenger” species. The “Albatross” took one specimen in the Sagami Sea which was sufficiently different from Lyman’s species to warrant its description as a second member of the genus. The “Valdivia” met with none, the “Albatross” in her very extensive Philippine voyage did not find it, and Dr. Mortensen in his visits to the East Indian region has not taken even one specimen. It is therefore of no little interest that the “Mabahiss” has secured specimens in the Gulf of Aden and that these prove to be the Japanese species. For obvious reasons it is a pity more and better material was not secured.

OPHIERNUS ADSPERSUM Lyman.

Ophiernus adpersum Lyman, 1883, p. 236 ; pl. 3, figs. 19–21.

LOCALITIES :

Station 35 ; Gulf of Aden ; 457–549 metres. Eleven specimens.

Station 37 ; Gulf of Aden ; 18–22 metres. Three specimens.

Station 158 ; Maldive area ; 786–1170 metres. One specimen.

Station 193 ; Gulf of Aden ; 1061–1080 metres. Three specimens.

RANGE.—Tropicopolitan in 291–3653 metres.

NOTES.—These specimens call for little comment as they are adults 10–15 mm. across the disk, with arms about eight times as much. It is obvious that the specimens said to be from “Station 37” did not come from there. They are in very poor condition, having the appearance of coming from a great depth, and probably are from deep water in the Gulf of Aden.

REMARKS.—This is one of the most typical of deep-sea ophiurans. The extension of its range by the “Mabahiss” to the Maldives and the Gulf of Aden is quite interesting, as it has not hitherto been known from the area between India and Africa. So the statement that it is tropicopolitan is further justified.

OPHIERNUS VALLINCOLA Lyman.

Ophiernus vallincola Lyman, 1878, p. 122; pl. 6, figs. 170-172.*Ophiernus seminudus* Lütken and Mortensen, 1899, p. 105.

LOCALITIES :

Station 26; Gulf of Aden; 2312 metres. Three specimens.

Station 62; northern area of Arabian Sea; 1893 metres. One specimen.

Station 85; northern area of Arabian Sea; 2000 metres. Four specimens.

Station ? One specimen.

RANGE.—Antarctic Ocean near Crozet Island; off southern and eastern Africa; off tropical America in the eastern Pacific; 825-2475 metres.

NOTES.—These are very typical specimens, ranging from 8 to 21 mm. in disk diameter. A field note with the specimen from Station 62 says: "Colour (Ridgway). Arms; dragon's blood red, the distal end of each articulation lighter. Disk, oral surface, madder blue, rimmed with dragon's blood red; aboral surface, madder blue with heart-shaped patches of dragon's blood red at tip of each lobe. Matched in sunlight." This is the first information we have had as to the colour of *Ophiernus* in life. It rouses our curiosity as to whether *adpersum* shows a similar coloration or is essentially different.

REMARKS.—The short, more or less circular radial shields on a disk which is otherwise almost or quite bare of scales or other calcareous matter distinguish this species readily from the far more widespread *adpersum*. Hertz (1927, p. 114) expresses the opinion that Lütken and Mortensen's species of *Ophiernus* from very deep water in the eastern tropical Pacific to which they gave the name *seminudus* is identical with the South African and Antarctic species which Lyman long before called *vallincola*. After a very critical examination of type material of each and of the present "Mabahiss" series, I am reluctantly compelled to agree with her, for I cannot find a single character in which the two forms differ consistently. As the Danish authors were themselves dubious of the validity of *seminudus*, it is quite proper to relegate it to synonymy.

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